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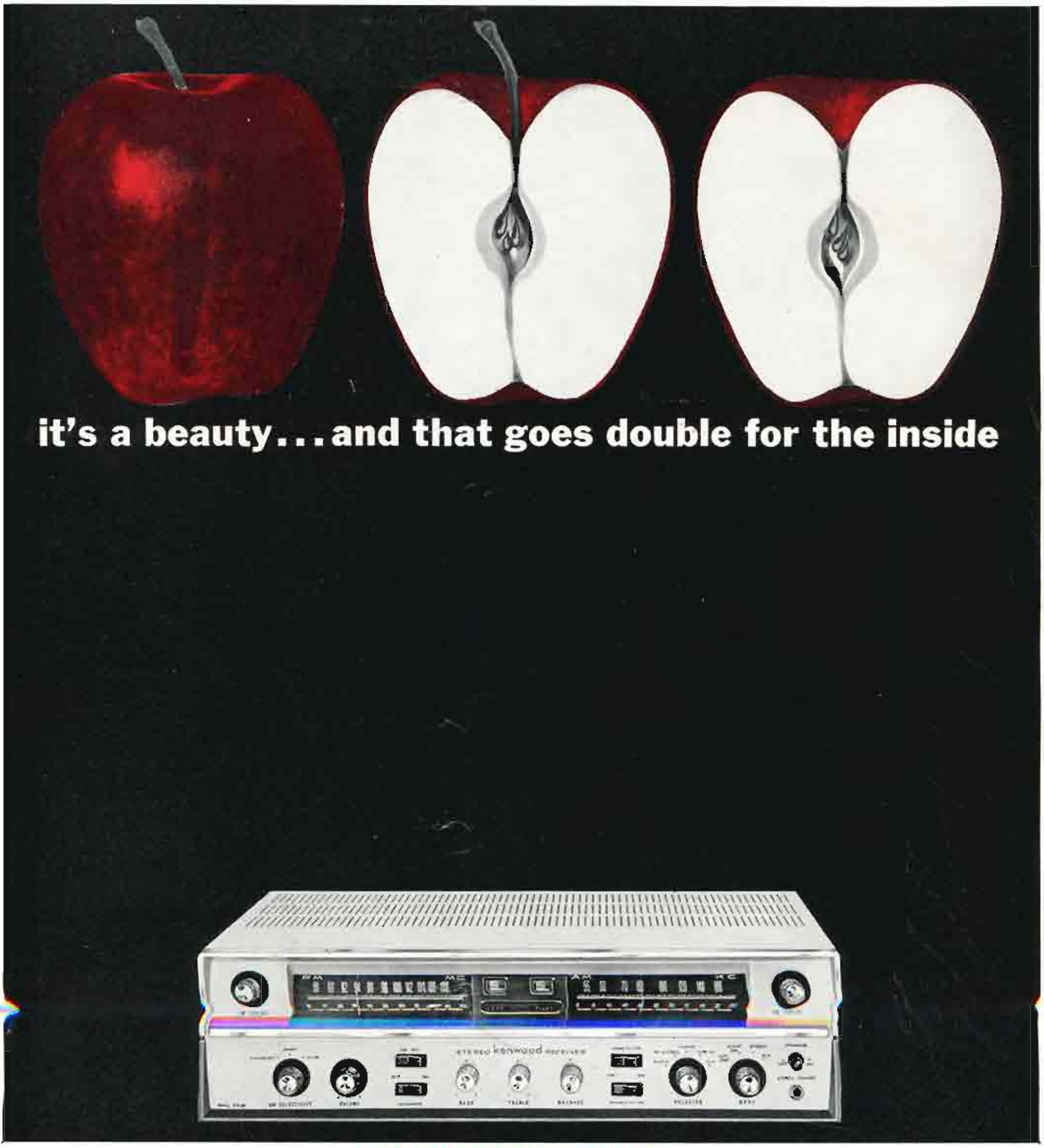

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OCTOBER, 1962 Vol. 46, No. 10
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AUDIO CLINIC

Joseph Giovanelli

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Good Servicing

Q. My Browning FM tuner, purchased early in 1954, worked beautifully. Now it is failing to tune out interference from adjacent stations. I have checked tubes a couple of times lately. The tubes are all right. I tried checking capacitors for shorts, but in some cases that is not possible without taking apart some of the very complicated assembly. Several capacitors show little or no resistance when tested with a VTVM, which fact is probably caused by the ohmmeter current being bypassed around the capacitor by other circuit elements.

I am inclined to think that my trouble may have come from a realignment I had done not long ago. If I knew a really trustworthy serviceman, I would take the tuner to him. I do not know how to locate such a person.

I had the realignment done, not because the tuner was malfunctioning, but rather because it had been used long enough so that I thought it should need it. Now I can receive only a few of the many locally available stations. A few come in clearly, but most do not.

Have you any suggestions as to where I can obtain a schematic for my tuner at this late date? L. C. Whitaker, Los Gatos, California.

A. The trouble you are having is caused by the misalignment of the i.f. stages in your tuner. This misalignment could be caused by a defective tube or other component (such as a shorted capacitor across one of the windings) in the i.f. strip. I hardly think this is the case. Fortunately, the i.f. in this tuner is rather easy to align. It is the r.f. section which can give trouble.

Unfortunately, I know of no service shop in your area capable of giving your tuner the realignment that it needs. If it is at all possible, the man who did the original alignment should be made to do it properly on a second try.

Unfortunately, it is all too likely that this man is capable of doing only mediocre work at best. (This is all too often the case, at any rate.) In my opinion, the lack of capable and dedicated servicemen is a serious problem confronting our industry today.

What real answer can I give correspondents who describe this same situation?

As to where to find a schematic for the tuner, I suggest that you obtain the *Photofact* (Howard Sams) which covers your model. These books are sold at most radio distributors. It will also give alignment instructions.

A Variable-Speed Record Player

Q. I am studying the piano and I use my record player to analyze music recorded by well-known artists. Frequently the tempo is too quick for me to analyze the value of each note. I use 45-rpm records on a single-speed player. I have tried these records on a slower-speed machine. There is a lowering of pitch and tonal quality. I would like to know if there is a way to alter the record player or attach anything to it to vary speed in order to hear and follow each piano note distinctly without adverse effects. I want to be able to count each note value accurately until the composition is memorized, fingers trained, gradually working up to the correct speed. Joseph Russi, Roxbury, Massachusetts.

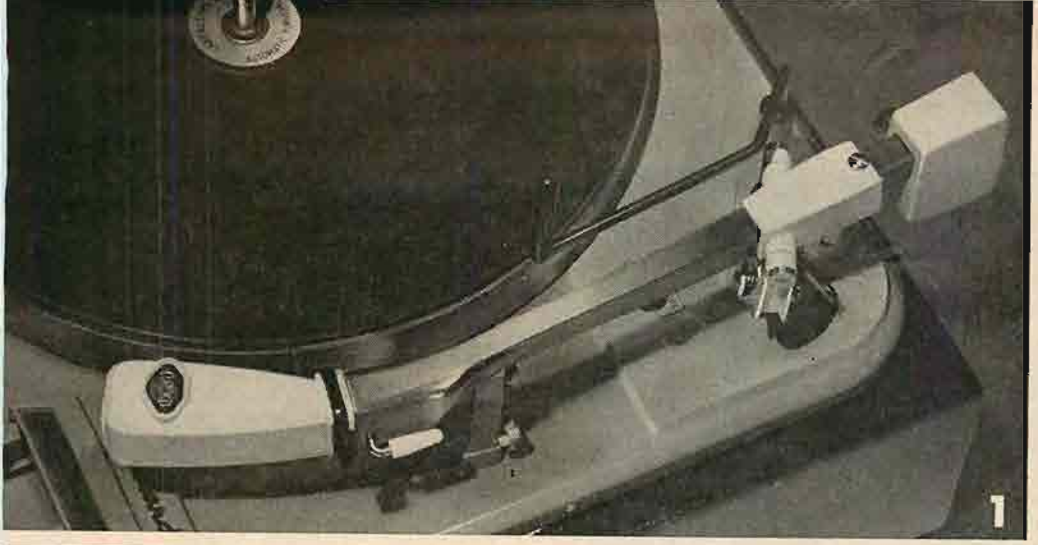
A. One approach to the problem of varying the speed of the recordings in which you are interested is to disconnect the record-player motor from its existing circuitry and connect it to the output of an amplifier, which in turn is fed by a variable-frequency oscillator. This oscillator must be capable of operating at frequencies below 60 cps, the a.c. supply frequency.

This is likely to be an expensive proposition because the power requirement is such that the amplifier would have to be capable of supplying as much as 40 watts at an impedance of roughly 200 ohms. However, when the motor is operated at lower than normal speed, the reactance of its windings will be reduced. This will lead to an increase in the amount of current that it draws, which, in turn, will lead to an increased amount of heat being produced in these windings. This could be sufficient to damage the motor.

Another possible approach would be to use a record player capable of operating at 33⅓ rpm. When this motor is used in conjunction with the audio oscillator-amplifier arrangement just described, the frequency of the oscillator must be raised above the power supply frequency of 60 cps in order to cause the motor to rotate at speeds between 33⅓ and 45 rpm. By this means it may be possible to reduce some of the overheating effect. Of course, the reactance of the windings will rise and it may be harder to drive the motor under this set of operating conditions.

One other approach would be to grind a motor shaft down to a size which would produce the slowest required speed. Then a succession of little collars with graduated diameters could be machined. Thus, a variety of speeds would be provided with the motor turning at its normal speed and connected to the power line.

One word of caution about your entire scheme is in order. As the speed changes, so does the tempo, but so does the pitch. Therefore, while it is possible to distinguish rythmic patterns, it will be difficult to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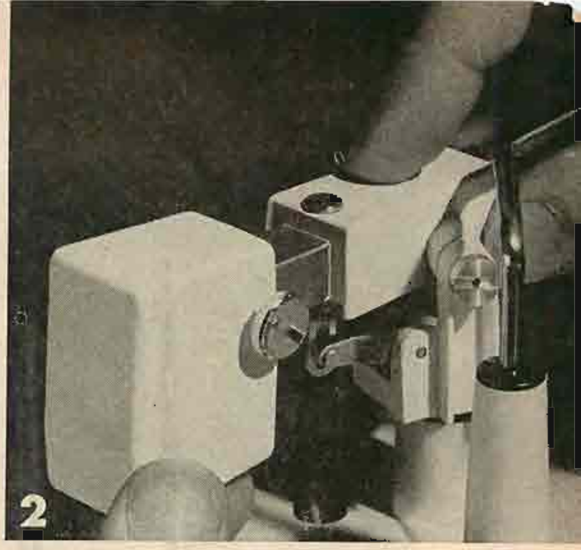
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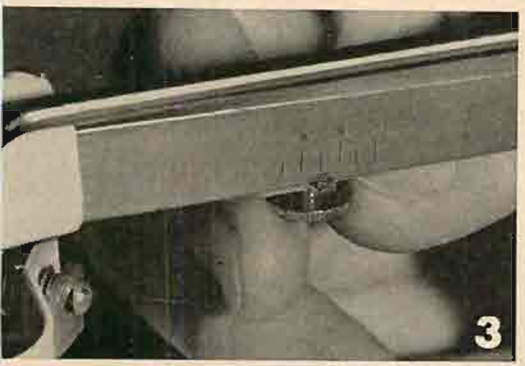
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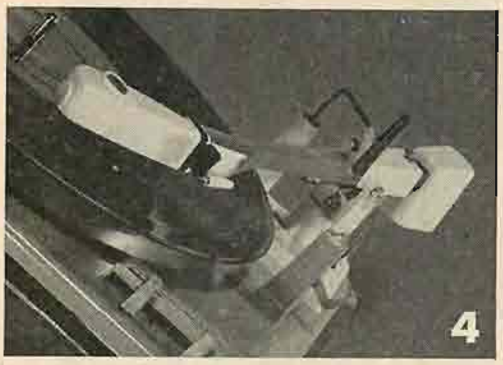
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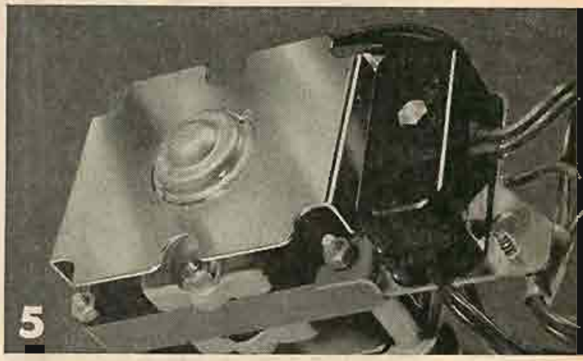
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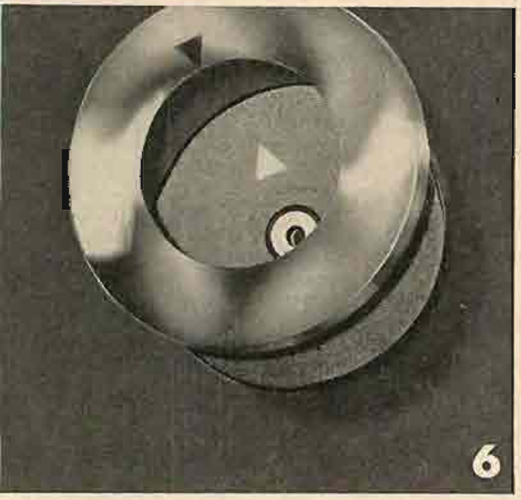
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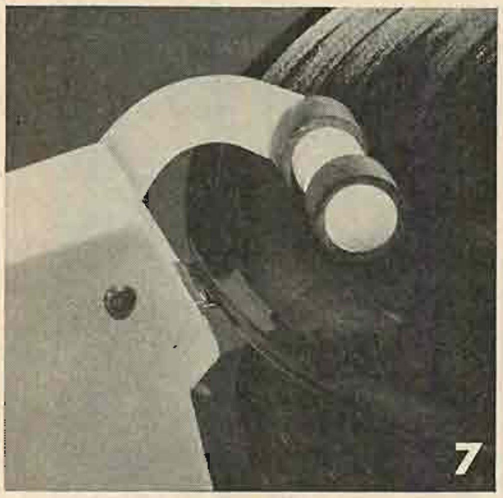
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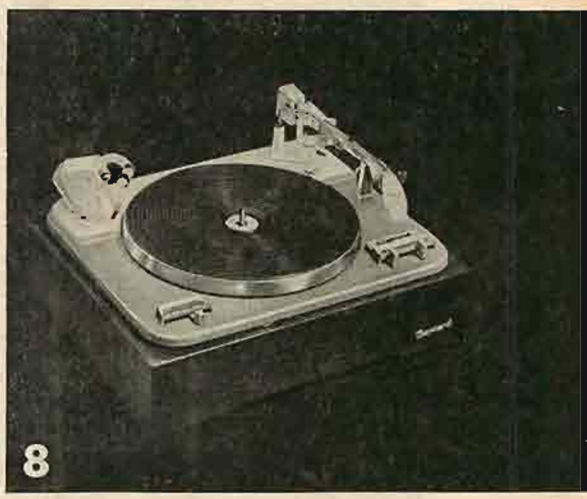
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1. Dynamically-balanced tone arm of the showing plug-in shell, pivot mounting, and heavy counter weight. This precision arm has been factory installed and integrated with the record playing unit. It is comparable to those in greatest demand for separate purchase with professional turntables.

2. To set stylus pressure, counterweight is moved first...sliding along the tone arm until it floats freely on a level, in perfect balance. This establishes "zero" pressure.

3. Once at "zero" pressure, the arm is set at the correct tracking force designated by the cartridge manufacturer, using a gauge built into the side of the arm. Just about any cartridge may be used, including the ultra-sensitive high compliance "professional" types developed originally for separately sold arms.

4. Now that the arm is balanced and stylus pressure accurately set, it will track each side of the stereo groove perfectly, even if the entire player is intentionally tilted or the record warped. The cartridge is allowed to perform to its full capabilities, without distortion; and the arm is in all respects kind to the delicate record.

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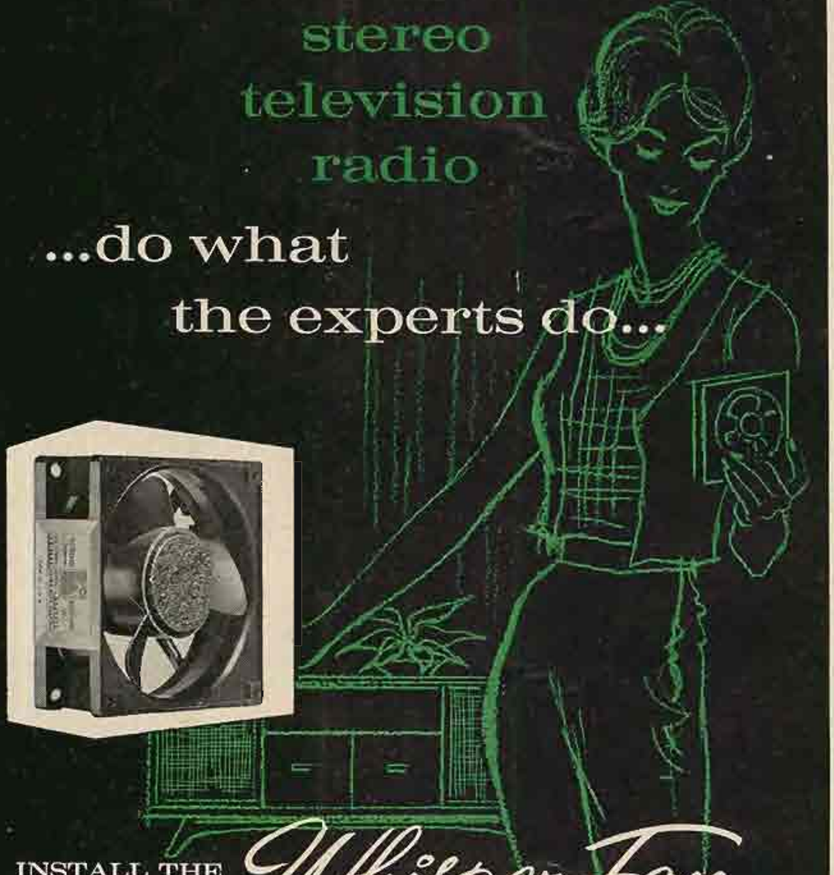

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memorize a piece of music note-for-note. Remember that for each speed there will be a consequent change in key and unless you are an expert at transposition, I suspect that you will encounter considerable difficulty. If I were following this procedure, I would memorize as much of the selection as possible at the original speed and in the original key. I would confine my use of the slower speeds to those instances where rythmic clarification is needed. Once the difficult passage has been grasped rythmically, the notes themselves can probably be memorized while the record is playing at normal speed.

Replacing an Output Transformer

Q. I have an old amplifier which has a very small and light output transformer. I would like to know the following:

1. Can I noticeably improve the response of the amplifier by substituting a better output transformer?

2. How can I determine what type to purchase?

3. If it will not fit on the chassis, which is small, can I mount it alongside the amplifier (which is in a large cabinet)? Ernest Lumer, New York, New York.

A. You can definitely improve the performance of your amplifier by replacing the output transformer with one having a heavier core. Of course, this pre-supposes that the transformer is really undersized for the amount of power it is expected to handle. Many amplifiers fall in this category so that this is a likely supposition. Most probably it will not fit on the chassis, therefore you can place it alongside the amplifier in your equipment cabinet. (It is probably a good idea to do this and leave the original transformer mounted on the chassis. Rewiring will thus be made easier, should you wish to sell the equipment. The holes drilled into the chassis to allow the leads from the new transformer to enter can be easily filled with plugs made for this purpose. You may not be concerned with this aspect of the conversion at this time, but it is well to leave the door open.)

As to the kind of transformer to buy, the best way to decide that question is to search the catalogs for a transformer which is designed to match the output tubes used in the amplifier. If you do not know the impedance required by the output stage, you may find it by using the tube manual. (It may be necessary to redesign the feedback loop). Æ

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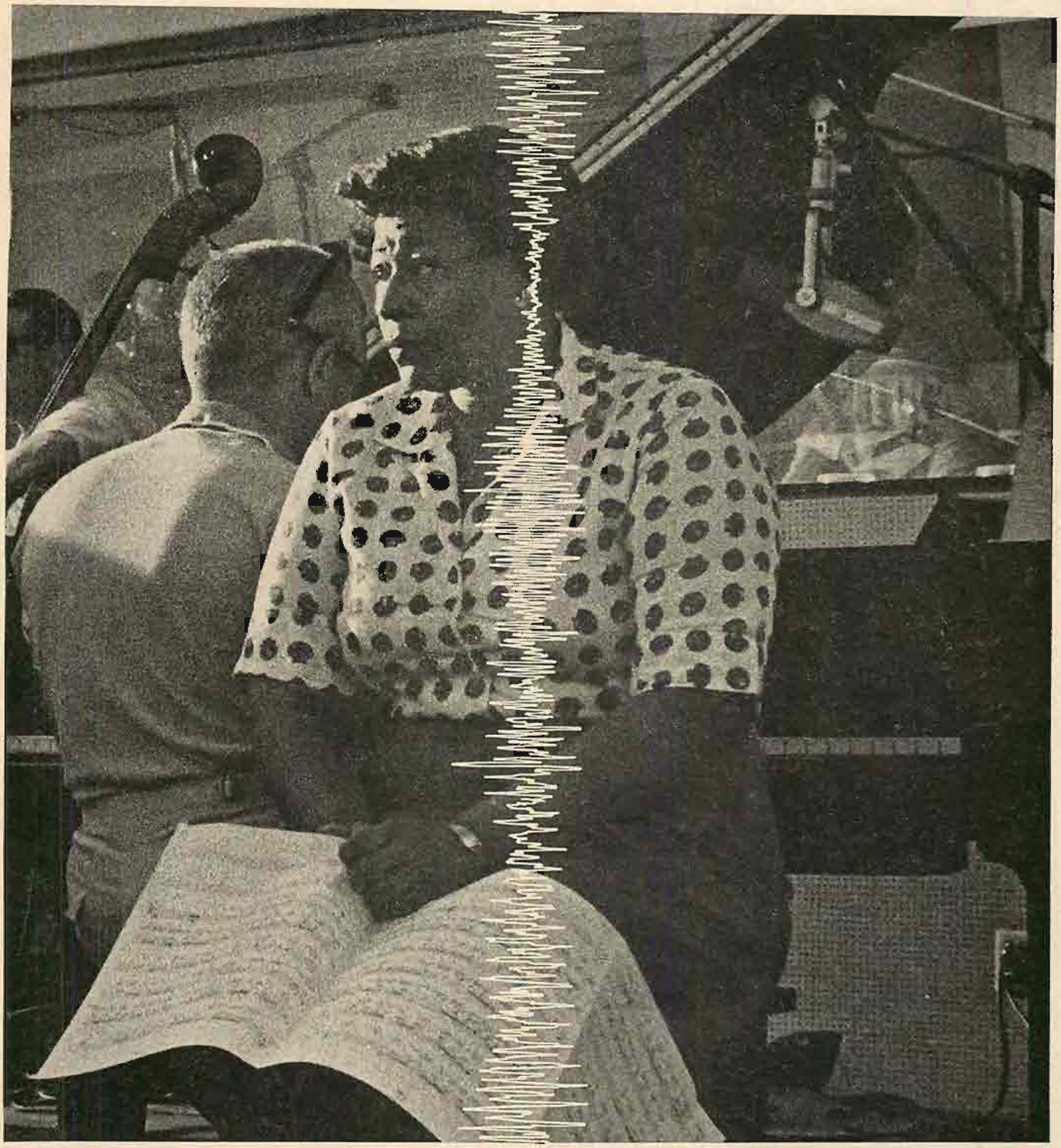

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LETTERS

Look Here, Mr. Canby!

SIR:

After several years of subscribing to AUDIO and successfully resisting the mild urge to pour forth my trivial dissentions with an occasional author's article, Mr. Edward Tatnall Canby has finally spurred me to action!

Despite my frequent skepticism and inability to duplicate many of Mr. Canby's subjective findings relative to two of his pet projects, earphone listening and FM-multiplex reception, I must admit that I generally enjoy his approach immensely. Only his apparent disdain for the fundamental enginering approach and his nonchalant, indeed gleeful, comments on his personal abuse of equipment, become occasionally irksome. For example, some of his remarks as I best recall them: ". . . I never make measurements . . . amplifier manufacturers would faint at running their equipment into zero and infinite loads but I do it often . . . it says not to change speeds while the machine is running but I did it several times . . . either the truckman or I, probably I, dropped the tuner . . .," and so on.

Mr. Canby's safaris into the realm of psychoacoustics (a most complex subject demanding exhaustive research and competency on the part of the experimenter in order to draw valid conclusions and generalizations) are quite amusing, I have never read of a subject such as two-channel earphone reproduction more beaten, flayed, buried, reincarnated, digested, regurgitated, and rebeaten than this one. I actually feel *sympathy* for the earphones, after reading one of this never-ending series, similar to what I would feel for a patient who had just undergone an operation for a non-existent ailment, diagnosed and performed by a high-school biology student! Yes, Mr. Canby, most earphone listening results in an artificial aural atmosphere. No, Mr. Canby, most of us do not emerge from a bout with the earphones dripping sweat and ready for psychiatric treatment brought about by "one-eared distortion." No, Mr. Canby, most of us do not suffer dizzy spells from highly separated source material, nor do we feel a mystic ancestral urge to almost completely blend the channels to alleviate that unbearable "one-eared distortion." (Also, by the way, Mr. Canby, most of us can discern modest amounts of blending *faster* with earphones than speakers and certainly do not have to approach anything near your "90% blend" to detect a difference.) Say, Mr. Canby, what kind of earphones do you listen to anyway? If it's the pair you recently commented on that you played loud enough to be heard in the next room, perhaps they are in need of repair . . . perhaps? Or perhaps your ears need more minor adjustments, or perhaps a little recalibration. . . ??

Now, with regard to FM-multiplex reception. . . . In August AUDIO, Mr. Canby tenderly took us through the trials and tribulations, pathos and ecstasy, of receiving an FM multiplex broadcast at the *incredible* distance of 100 miles—with the aid, of course, of a top-notch (I guess) antenna and a superlative (I guess) tuner. (Woe, the broadcast did have some noise, however.) Having recently completed a rather modestly priced tuner and integrated multiplex adapter kit, and having received not one but *three* multiplex stations transmitting at distances of approximately 130 miles (plus seven local multiplex stations within a 75-mile radius) with *no* audibly noticeable signal distortion, loss of separation, fading, and of white noise content just perciptibly higher than a comparable local mono broadcast, I feel that your "faint praise damnation" is far from representative of the present state-of-the-art. It follows that your remark" . . . you're not supposed to listen to multiplex 100 miles away . . ." is rather questionable, i.e. absurd. By the way, Mr. Canby, the "antenna array" utilized in my home for such "phenomenal" results is a folded dipole constructed of lead-in wire supplied with the kit. Also, Mr. Canby, the Southern California terrain is not exactly flat and eminently suited for FM reception. Far from it! Nor is my home located on a mountain top; and, in fact, several mountain ranges lie between the line of sight of these three "distant" transmitters and my little antenna.

Alas, Mr. Canby, in light of your treatment of equipment, IT'S A MIRACLE THAT ANY OF YOUR EQUIPMENT WORKS AT ALL!

JERRY P. DAVIS
5252 Gould Avenue
La Canada, Calif.

(*Take that and that, and that. But you'll get your turn next month, Mr. C.*—ED.)

Plug-In Heads Aren't New

SIR:

Your "Editor's Review" in the August issue relative to plug-in tape heads was of considerable interest to me. I was forced to read it twice to ascertain if you were advocating this design approach, or if you were proposing it as an original idea of considerable merit. From your comment that there might be sound economic reasons as to why this approach is not practical, I *assume* that it is the latter reason.

I, therefore, submit that plug-in heads have been available in commercial recorders for approximately ten years or more. My first recollection is the Grundig Model 819, followed by the 820 although, of course, there may have been earlier models with this feature. These recorders were, for the period of time and price bracket, superior quality instruments utilizing 3-pin plug-in heads (4) with circular removable mu-metal shields, and adjustable (3-point) base plates for all heads. In addition to these features the two speeds and directions were controlled by individual windings on a hysterisis synchronous motor, and all action was of the pushbutton, relay/solenoid type.

WILLIAM G. DILLEY
577 East Avery Street
San Bernardino, Calif.

SIR:

With regard to your editorial in the August issue, I would like to add my support to your suggestion concerning the availability of plug-in heads which could ensure accurate alignment. It is this very point which has prevented me from entering the tape field.

JAMES O. HIBBITS
8535 Brent Drive
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Kismet (Original Broadway Cast)
Columbia OS 2060

Alert readers (do we have any who are not?) have already spotted the reason why these famous monophonic show albums are being considered in this month's column. The story, of course, lies in the inclusion of the letter "S" (for stereo) in the new numbers assigned to these staples of the show music catalog. Columbia Records, after holding out for several years, has finally decided to join the roster of major labels issuing pseudo stereo editions of outstanding mono recordings made before the advent of stereo. Decca, RCA Victor and Capitol have all tried their hand at re-channeling valuable mono material in order to give it some of the attributes we take for granted in a full-fledged stereo recording. Some conversions have been more successful than others in presenting part of the stereo illusion. Unfortunately, until Columbia gave it a try, pseudo stereo had too many drawbacks to make it seem worth while. The electronic legerdemain employed up 'til now introduced several varieties of distortion—any one of them enough to outweigh the steps that had been taken in the direction of stereo sound. Columbia, it seems to me, is the first outfit to re-channel mono without introducing distortion within the sonic range or pulling the stereo images out of shape. Listening to these familiar-for-a-decade performances of "South Pacific" and "Kismet," it soon becomes clear that Columbia's engineers owe much of their success to a line of reasoning that steers away from the impossible. In "South Pacific," when Mary Martin and Ezlo Pinzo appear in their first duet in the *Twin Soliliquies,* each voice is only a foot or so to the right and left of center on the average stereo setup. The chorus of Seabees may not stretch across every inch of space between the loudspeakers yet solo voices are very easy to spot in their separate locations. Whatever amount of phase adjustment was used in the re-recording process, it was obviously handled with circumspection. The workings of the multiple-dividing networks defy detection so long as both channels are in use. The best clue to the simplicity of the Columbia re-channeling process appears when you audition the right and left channel of these records separately. The division of the sonic spectrum —highs to the left and lows to the right—is unusually straightforward for such an operation. The prudence shown throughout both of these albums is especially noticeable in the Kismet recording. No attempt whatsoever is made to separate the voices of trios or quartets as they become entangled in the Wright-Forrest lyrics set to the ornate music of Alexander Borodin. In *This is My Beloved,* based on the third movement of Borodin's famous Quartet in D Major, Alfred Drake, Doretta Morrow, Richard Kiley and Henry Calvin blend their voices within the same area they occupy when the old mono recording (Columbia OL 4850) is played through a stereo system. After careful consideration of Columbia's re-channeling process, one is tempted to request the re-mastering of additional material now reposing in their mono vaults.

Boston Pops: No Strings and State Fair
RCA Victor LSC 2637

The sound of the last Boston Pops stereo record reviewed here, you may recall, left no joy in this corner. The Pops Roundup album (LSC 2595) was a departure from the usual miking of Boston's musical pride and joy. When this album of Richard Rodgers tunes made its appearance, I checked it first before sampling any of the other RCA discs in this month's release. To my relief, the first tune from "No Strings" unrolled into the living room in the normal sound we have come to expect from Arthur Fiedler and the men of the Pops. As arranged by Jack Mason, the top songs from No Strings receive the classiest treatment they've enjoyed so far on records. My favorite ballads in the show, *Sweetest Sounds* and *Nobody Told Me*, take on the color that only a top-notch string and woodwind section can possibly give them.

The selections from "State Fair," in special arrangements by Richard Hayman, include the two brand new songs Rodgers added to the score of the latest motion picture version. *More Than Just a Friend* and *Willing and Eager* were written by Rodgers on condition that he be allowed to supply the lyrics of the additional tunes. In a gesture typical of those in the very top rank of current composers, Dick Rodgers assured the movie studio that it was under no obligation to use the songs should it find them unsatisfactory. The inclusion of the new songs in this recording demonstrates that Arthur Fiedler shares Hollywood's opinion regarding the acceptability of Rodger's latest film effort.

Ian Fraser: For the Young at Heart
Richmond Tape RPX 49009

The latest series of tapes on the Richmond label offers further evidence that the percussion craze of the past few years has run its course. During the period when the popularity of percussion recordings was at full tide, tape fans had ample opportunity to see how the laws of supply and demand kept the price of percussion reels up in the neighborhood of eight dollars. Several labels, of course, were willing to divest themselves of unlimited quantities of percussion tapes at that price but virtually nothing was available to the tape fan looking for percussion releases in the $4.95 price range. Now Richmond, long active below the five dollar price border, has issued a new group of tapes in a special series called "Percussive Stereo." It would be slightly wide of the mark to call this group of releases a "poor man's" Phase 4 Series because the separation nowhere approaches the exaggeration of the higher-priced London line. Movement of soloists in this reel by the Ian Fraser orchestra is held to a minimum. The only gimmik used in the arrangements is the venerable one of repeating in the left channel a phrase just heard in the right channel. In all fairness, it should be pointed out to anyone contemplating a sizeable investment in percussion tapes at this lower price that the performances simply do not approach the deft smoothness of the outfits featured on the earlier percussion recordings. The sound could be called only middle-of-the-road at best since there is little evidence of the startling presence that first catapulted this type of recording into the limelight.

Roland Shaw: Band Concert
Richmond Tape RPX 49012

The lineup of marches by Sousa, Alford and Bagley is a familiar one but this is not a band concert in the usual sense of the phrase. The explanation lies in the full title of the performing group. *This tape* features the Roland Shaw Band and Orchestra in a collection of standard marches. The idea behind the album is a fairly novel one, combining the virtues (if band purists will accept that term) of a large dance orchestra with that of a versatile marching band. As soon as the band instruments establish the identity of Sousa's *Semper Fidelis* or Bagley's *National Emblem,* the Shaw arrangements suddenly introduce the saxophones and clarinets of a swinging dance band. Throughout the program, the band elements have no trouble keeping themselves in a predominant position but this reel cannot be listed under the heading of regular band music.

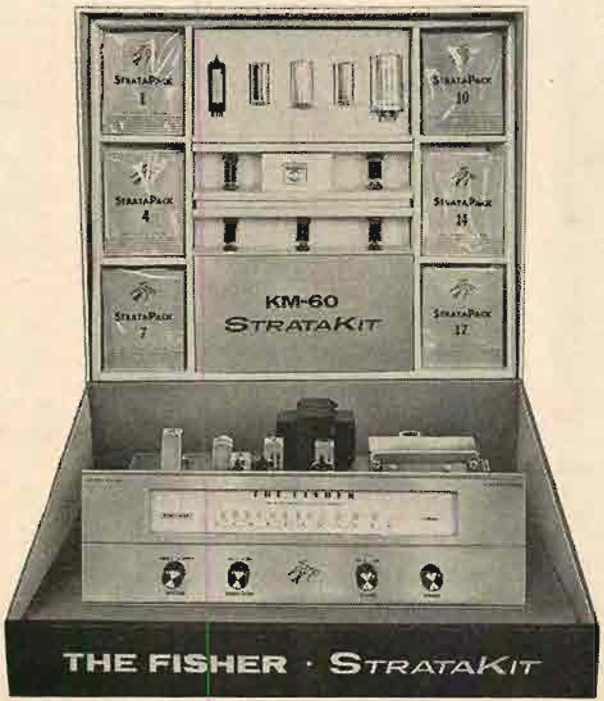
The audio quality of the tape received for review is a pretty dismal affair. It is quite obvious that this particular reel is an exception to the rule because the other Richmond tapes received the same day boast normal processing. The least likely adjective that could be applied to the sound of this four-track reel is the word robust. The mid range is weak and the highs begin to assume normalcy on a large system only when you introduce a sharp cutoff at 7000 cps. It's not easy to explain this state of affairs in the equalization of these Richmond reels because the companion tapes in the same month's release behave pretty much in the manner of Richmond tapes of the past. That is, the pre-emphasis in most cases is quite moderate up to 10,000 cps. I find that any steep upward curve above that figure can be smoothed out without too much difficulty. The messy part of the job comes when you try to get rid of excess pre-emphasis below 10,000 cps. It's one thing to match a known curve when you're compensating for unwanted highs; it's quite another matter to try to overcome a goof on the part of some technician who set the equalization when running off this particular tape. No one can deny that the duplicating staff of United Stereo Tapes has its hands full when it comes to figuring out the equalization for all the different labels they handle in the course of a daily run. Assuming that the Richmond working tapes sent over from England were similar in equalization, it should be possible to provide four-track duplicates that are uniform in equalization within a given label.

5 Guitars . . . 50 Fingers
Richmond Tape RPX 49011

Of the three Richmond tapes reviewed this month, the best sounding one is this reel starring guitars, drums and Hammond organ under the direction of Mark White. On more than one occasion during the course of this tape, one is tempted to speculate about the possibility that a five dollar tape delivers its best results when the musical instruments involved do not present too serious a challenge to the recording process. Such a conclusion is almost unavoidable when you weigh the differences in the latest Richmond tapes. The small group heard here in closeup enjoys cleaner sound throughout the range of the tape and the balance of highs and lows presents no problem in playback. More than most Richmond releases, this reel goes in heavily for novelty effects designed to enhance the tonal range of the guitar. *Mack the Knife, The Hot Canary,* and *Swingin' Shepherd Blues* provide some of the more obvious outlets for the arranger's playfulness.

Julie and Carol at Carnegie Hall
Columbia OS 2240

This release underlines in no uncertain terms the basic problem encountered in transferring a musical TV production to the record medium. When Julie Andrews and Carol Burnett appeared on television at Carnegie Hall some months ago in a show tailored to their unique talents, Columbia Records taped the audio portion of the program for release in this form. I sampled the record with considerable curiosity because I happened to catch most of the televised program during one of my rare evenings at home when turntables and tape reels were stationary for an hour or two. Here was one occasion when a reasonably accurate comparison could be made of the entertainment values inherent in stereo sound as opposed to mono sound coupled with TV picture. Considering the present recording



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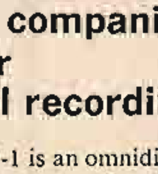

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and the television production that preceded it, one factor does not stand out in the comparison. Contrary to my expectation, stereo doesn't play as important a role in the recorded version as I thought it would. For all the added presence that the stereo recording provides—and the sound is right up there with Columbia's best—it would appear that stereo and improved frequency response cannot substitute for the information that the eye takes in when two first-rank professionals are vying for attention in the spotlight. Certainly no recording, mono or stereo, could begin to capture the roguish parade of uninhibited facial antics that are the stock in trade of Carol Burnett. On the other hand, without these very same visual attractions (or are they to be labelled distractions in this case) the impartial microphones reveal a Burnett singing voice that is far more pleasing and substantial than the one heard on a typical TV receiver. Julie Andrews, of course, registers with equal effectiveness in each medium. Considered with any degree of objectivity, the first three production numbers on the record are hardly worthy of profound attention. Things do begin to pick up a bit when the entire cast goes into a takeoff on the Moiseyev Dance Ensemble and a parody of the Trapp Family which served as the inspiration for the musical, "Sound of Music." The highlight of the show, and the record, is the smooth flowing medley by Julie Andrews and Carol Burnett tracing the history of musical comedy from the days of the Floradora shows to the tough, hard-as-pavement lyrics of Leonard Bernstein's "West Side Story." An amusing moment in the middle of this kaleidoscope of melody occurs when Carol Burnett preempts the famous *Wouldn't It Be Loverly* from Julie Andrews' "My Fair Lady." The free-wheeling finale finds the stars tearing down the rafters with a Texas-size version of *Big "D"* from Frank Loesser's "Most Happy Fella" as an appreciative audience proves that it's still the best tonic available to any recording artist.

Patrick Galvin: Irish Drinking Songs
Offbeat 4022

Add a new name to the not inconsiderable list of singers who have come to records from the Emerald Isle. Patrick Galvin does not confine himself to Irish songs that might be encountered only when spirits are flowing freely. All the tunes recorded here by this subsidiary label of Riverside Records are songs that could be heard at any typical Irish get-together known as the "hooley." This terms refers to a social evening in Ireland that is apt to include dancing as well as singing, and food as well as drink. Whether the setting is a country kitchen or a more elaborate city public house, the occasion is never a solemn one despite the occasional inclusion of national (or "rebel") songs and ballads. Unreconstructed Hibernians may feel that this album includes a few too many tunes of Anglo-Irish origin for the makings of a completely relaxed evening but Patrick Galvin's unassuming demeanor is sure to beguile them whether he's singing a universally known barracks-room ballad such as *One-Eyed Reilly* or the most famous Irish drinking song of them all, *The Cruiskeen Lawn* (The Full Little Flask). There is no shortage of stalwart favorites throughout the album as sung to the accompaniment of the banjo and guitar of Al Jeffries. From the first words of the tongue-tripping *Sup of Good Whiskey*, sung to the tune of *The Irish Washerwoman*, to the final melody *The Parting Glass*, whose flavor of Robert Burns has not prevented it from becoming particularly popular in the southwestern counties of Ireland, this is one album that could help you see double without recourse to stereo.

Hugo Winterhalter Goes . . . Continental
RCA Victor LSP 2482

Most of the Winterhalter stereo discs have a unique recording curve that amounts to a sonic trademark. As in the case of other stereo discs that do not adhere to the RIAA recording characteristic, Winterhalter's recordings sound almost normal on my system when played at lower than normal volume. Raise the level a bit and the top end begins to sound cramped. It just doesn't have the freedom of the regular RCA stereo discs. At higher levels, the "Winterhalter" curve also takes on a tubbiness in the low end. On a reasonably flat system the confined highs present more of a problem than do the somewhat bloated lows. Where matters really get out of hand is on a sound system that has a peak in its speakers anywhere in the region between 50 and 100 cycles. Under those circumstances, the bass on this record puts on a thoroughly convincing imitation of an old-fashioned juke box standing on a loosely nailed floor. As for the musical contents of this record, the tidbits gathered from all the corners of Europe receive the predictably glib treatment that invariably sets apart most of the Winterhalter arrangements. If you're not in the mood for the sleek approach, it is possible to find more authentic-sounding versions of *Never on Sunday*, *Volare*, and *Mademoiselle de Paris*.

Philip Green: Great Waltzes from Gilbert and Sullivan
Riverside RLP 97530

It takes a record such as this one to remind us how little progress Gilbert and Sullivan have made in the catalog of instrumental recordings. I had always entertained the idea that, kicking around in stores, there were at least a half dozen non-vocal recordings devoted to light arrangements of some of the better-known nuggets from the enormous G & S storehouse. It was not until I began to search through the one LP catalog that every record dealer has to consult whenever a "difficult" customer shows up at his counter, that I began to realize how sparse the Gilbert and Sullivan instrumental repertory really is. In the first place, the section of the catalog devoted to Popular Music of this and other countries has no specific listing under either Gilbert or Sullivan. This, incidentally, is an old problem in the pop section of the catalog where you can find any recording currently in print—provided you have the name of the artist who recorded the darn thing. The listings under G & S in the classical section reveal, in addition to the regular recordings of the complete operettas, only a small handful of instrumental albums. This Riverside disc is only the second recording in the current catalog to offer excerpts from the full stage productions in arrangements for light orchestra. Two other albums (Angel S-35625 and S-35788) offer band music from G & S scores as played by the Scots Guards Regimental Band and the Band of the Royal Military School of Music respectively. This latest release in the Riverside popular series concentrates on a dozen waltz songs found in eight Gilbert and Sullivan operettas. Since this recording, like the Angel releases for band, was produced in England, the idiom has been well preserved in special arrangements by Philip Green and his orchestra. The stereo sound is considerably richer and cleaner than the mono sound of Riverside's earlier English releases.

Cy Coleman: Broadway Pianorama
Capitol ST 1740

A chap may play a fine piano for years at supper clubs in top Manhattan hotels and achieve only modest fame—until he writes the score for a major Broadway musical. After that, it's only a question of time before a major record label decides that his piano playing deserves a wider audience and invites him to survey the Broadway scene from the vantage point of his keyboard. Such a combination of events underlies this particular recording by Cy Coleman. The breezy score penned by Coleman for the Lucille Ball musical, "Wildcat," placed him several notches above the other cocktail pianists still trying to make themselves heard over the clink of glasses. His fresh slant on some of the great Broadway shows of the past is neatly packaged in this new Capitol release. Assisting Coleman is a discreet trio made up of guitar, bass, and drums. Another trio, this one comprising three feminine voices, is heard in just a phrase or two of a lyric at the opening, and again at the close, of each song. This helps to identify some tunes that go back to the mid-Forties. In addition to well-known scores such as "Guys and Dolls," Kismet, "Finian's Rainbow," and at least one tune from "Wildcat," several shows that deserved

(*Continued on page 86*)

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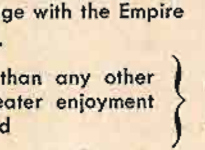

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SOME DOUBTS ABOUT BALANCE

The sweetest agony in hi fi is that of doubt. Where would we all be without it? Doubt and enthusiasm go hand in hand. The hi-fi enthusiast is by definition the hi-fi doubter too. You seldom find the one without the other.

Buy a new diamond stylus and the next day—doubt creeps in. Is that ever-so-faint distortion still there? Is the new needle defective? Is there something else wrong and it wasn't the old needle at all? The preamp on the blink again? That new tweeter—maybe its cone is rubbing?

Treat yourself to a test record and then find out how deliciously doubtful is every aspect of your stereo performance. *One thousand cycles — set level . . . twenty thousand cycles . . . eighteen thousand —* What? The system isn't passing eighteen thousand? Nothing but needle scratch? Or maybe you're just getting old. Dreadful thought—never again the sound of eighteen thousand cycles! Let's try it louder. ONE THOUSAND CYCLES—SET LEVEL. In an hour you'll be a nervous wreck, and loving every minute of it.

Of course you can't go around having doubts about positive things like complete breakdowns. Tubes go red and blue and smoke pours out. One speaker goes dead. The diamond stylus hits a scratch and flies out of its mounting, leaving a hole that fuzzily plays two adjacent grooves at the same time. These things are beyond doubt; they can be fixed and all you need is cash, which is always a pleasure to spend and never more so than when you shouldn't be spending it. The doubtful things are the subtle things, the evanescent troubles, the subjective elements, the problems that can never be solved. Like stereo balance.

A letter reached me awhile ago, for instance, from a reader who shall be nameless, though his observations are reasonable and correct. He is "preoccupied," as he says, with the balance between his stereo speakers. He is doing some heavy thinking about it. "I spent a pile of money a few years ago on stereo equipment, and when the channels are balanced right it really sounds terrific. It sounds pretty good, too, when it is out of balance, but to get that marvelously *real* illusion that stereo can give, the balance has to be just right."

Ah, here we go! For how does one define just right? A fine doubter's paradise!

"I find that not all records seem to balance at the same setting of the balance control. I'm not sure whether this variation is due to vagaries of my amplifier or whether the records themselves have been cut with differences between the channel levels.... What I do when I listen seriously is to sit on my 'listening seat' and fiddle with the balance control until everything seems just right. Unfortunately, the record is sometimes half over before this happy state is arrived at.

"Of course if a record has an unusual balance point, I'll write it down on the back of the jacket; but new records sometimes entail the making of some rather agonizing decisions. And when the day comes that I have enough money saved up to buy an FM-multiplex tuner. . . ."

More complications, of course. But even without a tuner there are problems galore. He is entirely right. Even with an electrical balance meter, as this reader correctly foresees, doubts can still arise. He points out that last year I recommended a balance and phase meter (Stereosonics PH-1), saying that balance and phase were both easily determined by a glance of the eye. "Mail order catalogues . . . list several of these, but the descriptive literature accompanying them makes no mention as to how small a difference, in volts, the ear can perceive and whether the meter movements are of this order of sensitivity. I am still left with the gnawing question of whether the determination is as *accurate* as can eventually be accomplished by ear: after all, it is the ear that must be satisfied."

Right. I can assure him of one thing, The balance meter does determine the electrical balance between channels more accurately than most ears. To settle this point factually, you need only switch to mono, sending the same signal through both channels of your system, and the meter will balance the voltages to the speakers with all the exactitude you can ever need. But is this all? Far from it.

Stereo balance is one of those things that, as I once put it, involve plural troubles. Not one, but many factors are involved. You will worry yourself sick if you hope to find a perfect, factually correct balance for each stereo experience. Too many variables, some of in your equipment, others beyond your control in the recording and/or broadcasting. To enjoy stereo, therefore, one must strike another kind of balance, that between doubt and certainty, then learn to live with it. Beyond that point, no amount of "gnawing" is going to help, except that which can be satisfied by sheer listening, to find the most immediately satisfying arrangement. And it'll surely be one balance today, a different balance tomorrow.

The balance meter, if I am right, overlooks one factor, that of speaker efficiency. If your speakers are identical, as they should be, then their efficiency is the same. But if not, the electrical balance may turn out to be a lopsided one and you'll be back where you were, to the ear-adjusting system, for all your pains. The simplest way to get off to a good start, then, is to shove a mono signal through your two speakers and "twiddle" the controls until the sound-image is just halfway between speakers when you are halfway between them yourself. This will take efficiency into account and—another minor but crucial item—it will take into account the often considerable differences between the acoustical situation of the two speakers. A speaker with walls both behind and at one side will be louder than one placed against a single wall. Short of an architectural rebuilding or a redeployment of your whole system, or maybe a reflecting screen behind and around the "weak" speaker, the best thing you can do is to center the mono signal by ear where you want it, then shift to stereo. With luck, the stereo will sound balanced too. But don't count on it.

If you are persistent, of course, you won't be satisfied merely with a final balance; you'll want each element in your system in balance. What a field day for tinkering! First is your magnetic pickup. Is it uniform in the two channels and balanced in over-all output? A lot of them aren't or weren't. Even with handsomely similar curves, the two channels aren't always of an equal output. And some types tend to vary their relative output with gravity. That is, if your turntable leans to one side, the pickup will throw its output balance off-center. You could make a nice turntable level meter out of one of these by hooking it to a balance meter! Side pull in some changers causes the gravity-sensitive type of pickup to swing and sway the musical image from one side to the other, most seasickishly.

Balance out your pickup as well as you can via compensation elsewhere. There isn't much else you can do except turn it in for another if you find its two sides are unequal. (You can check this to some extent by using a channel reverse switch—but there are other things that must be checked and clear in your mind first, or you'll soon be in a mess of confusion.)

What of the phono preamplifiers? Is their gain equal, on the two phono channels? Also on the two tape-head channels, which normally are in the same circuit? With professional equipment you can check this sort of thing pronto but if you are merely a worried hi-fi enthusiast it isn't so easy. You can play off one factor against another—eliminate the pickup balance, for instance, by feeding only one of its channels into both preamps. Most control systems allow it. Some preamps have level sets for each input and lots do not. Either way, if you suspect a difference in preamp gain, just make yourself a mental note that you *think* one preamp has more umph than the other—and resolve to keep on checking. Chances are ten to one that you'll run into further contradictions that will have to be explained away.

Then there is the dual power amplifier. One of mine, a most respectable and dependable job, a sort of all-weather model (I've carried it through rain and snow and sleet), has from the beginning given me more umph from one of its channels than the other. The maker was most considerate; he put level sets on his inputs; so I can balance the sum-total of everything as it emerges from the amplifier. I just tone down the stronger channel to match the weaker one and let it go at that. Plenty of power left over. If I were really persistent, I suppose, I would remove all the tubes, match up new ones, and try again. Probably the output would swing the other way. I'm both mildly cynical and well contented with things as they are and I'm not worried at all. Not yet, anyhow. . . .

Let's not go into FM-multiplex balance. Frankly, my early experiments in multiplex tuning were balance nightmares. It wasn't the fault of the tuners—what plagued me was merely that a new pair of unknown signals was introduced into my carefully, beautifully, painstakingly balanced system and in seconds the whole thing was chaos! For, when you get down to it, most stereo rigs are a passel of "checks and balances," a batch of unbalances averaged out, a house of cards ready to fall apart, given a breath of change. And once you start trying to

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BUILDING THE SEMI-KIT:

The two most critical sections, the front end and 4 IF's through to the detector, are entirely pre-wired and pre-aligned for best performance on weak signals (fringe area reception).

For the third most critical section, the heart of the stereo demodulator, you simply mount and solder the components on a high quality circuit board. Pre-aligned coils eliminate all adjustments. The rest is non-critical and easily accomplished with the clearest pictorial drawings and most thorough-going step-by-step procedure in the industry.

THE CIRCUIT

the front end Consistent and reliable printed circuit. Ultra-sensitive, stable, and low-noise. Wide-band design. Rugged plated steel housing for protection and shielding. Meets FCC radiation requirements. Precise temperature-compensation for freedom from drift without AFC. AFC provided with defeat for convenience. Indirect gear drive is backlash-free and eliminates possibility of microphony.

the IF strip Four IF amplifier-limiter stages (all that will do any good) and an ultra-wide-band ratio detector, all pre-wired and pre-aligned. Designed with the utmost practicality so that the simplest alignment is also the alignment for highest sensitivity and practically lowest distortion. (Important to you if a service alignment is ever required.) Output is flat to the limit of the composite stereo signal frequency spectrum to eliminate any need for roll-off compensation in the stereo demodulator.

the stereo demodulator Ten stages for unequalled performance capabilities. EICO's brilliantly-engineered zero phase-shift, filterless detection circuit (patents pending) eliminates loss of separation due to phase-shift in the stereo sub-channel before recovery. Complete rejection of storecasting interference. Cathode follower driven, sharp cut-off 15kc low pass filters in each output channel.

THE OPERATION

Two slide-rule dials in a line: one, a station frequency dial with the famous EICO "eye-tronic"® tuning-eye travelling along it to indicate the exact center of each broadcast channel; the other a logging dial with an automatic stereo indicator lamp travelling along it in tandem with the tuning-eye to indicate when the station tuned in is broadcasting stereo.

THE LOOK

Massive extruded aluminum panel and side rails, exquisitely brushed and anodized pale gold, with baked epoxy brown, perforated steel cover.

PERFORMANCE

Pre-production field tests brought back the report "Definitely a fringe-area stereo tuner," which is simply the meaning of our laboratory measurements. We know, for example, that full limiting is achieved at 10uV input signal, meaning that the low distortion and noise specifications (the full benefits of FM) will apply to all but the most distant and difficult-to-receive stations. The sharp selectivity you need when a tuner is that sensitive is here also (a strong local station and a low-power station 100 miles distant separated by only 0.4 mc, each had its own sharp tuning-in point on the dial). While signal levels as low as 2.5uV will produce phase-locking for full stereo separation, very strong local signals will produce no higher output from the FM detector than a 10uV signal and will not be degraded in quality by overloading the stereo demodulator. Distortion is very low, both in mono and stereo, so that the sound you hear has that sweetness, clarity, and freedom from grating harshness that results from absence of distortion. The stereo output signals are so clean that there is not a sign of the 19kc pilot carrier or the re-inserted 38kc sub-carrier visible on a scope presentation.

SPECIFICATIONS

Antenna Input: 300 ohms balanced. IHFM Usable Sensitivity: 3uV (30db quieting), 1.5uV for 20db quieting. Sensitivity for phase-locking (synchronization) in stereo: 2.5 uV. Full limiting sensitivity: 10uV. IF Bandwidth: 280kc at 6db points. Ratio Detector Bandwidth: 1 megacycle peak-to-peak separation. Audio Bandwidth at FM Detector: Flat to 53kc discounting pre-emphasis. IHFM Signal-to-Noise Ratio: —55db. IHFM Harmonic Distortion: 0.6%. Stereo Harmonic Distortion: less than 1.5%*. IHFM IM Distortion: 0.1%. Output Audio Frequency Response: ±1db 20cps-15kc. IHFM Capture Ratio: 3db. Channel Separation: 30db. Audio Output: 0.8 volt. Output Impedance: low impedance cathode followers. Controls: Power, Separation, FM Tuning, Stereo-Mono, AFC-Defeat. Tubes: 1-ECC85, 5-6AU6, 1-6AL5, 1-12AT7, 2-12AU7, 1-6D10 (triple triode), 1-DM70 (tuning-eye), 1-EZ80 rectifier, 6 signal diodes, 1 neon lamp. Power Source: 117V, 60cps; 60 watts drain; extractor post fuse. Size (HWD): 5⅛" x 15⅞" x 11⅜". Weight 17 lbs.

*Actual distortion meter reading of derived left or right channel output with a stereo FM signal fed to the antenna input terminals.

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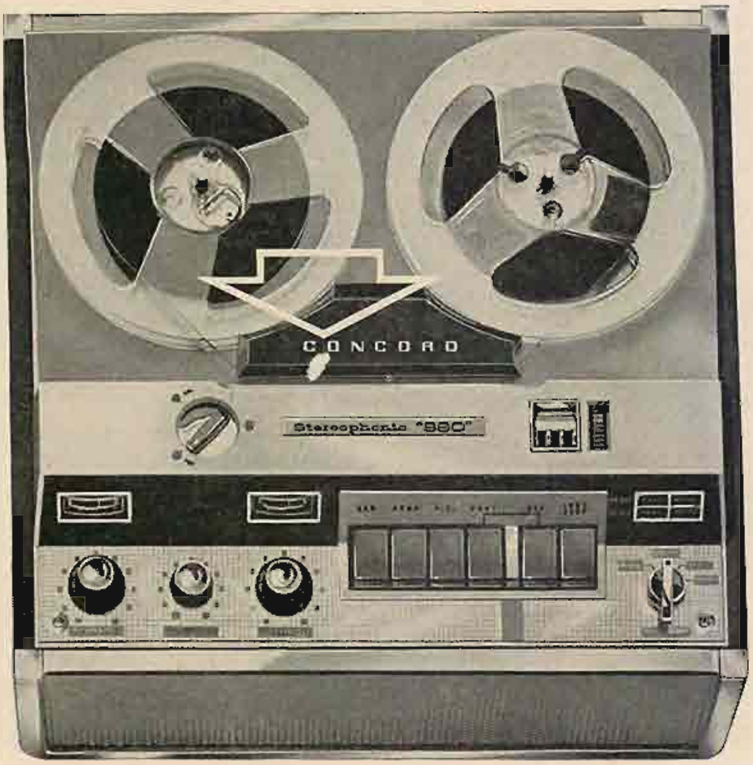

to make professional quality stereo tape recordings your recorder must have three heads

All professional tape recorders have three separate heads—one erase, one record, one playback. Record heads and playback heads have different gap widths. A wide gap record head is a must to record all the sound on the tape. A narrow gap playback head is a must to reproduce all the sound from the tape. Professional quality sound on sound recordings can be made only on a recorder with three heads.

The Concord 880 was designed for Connoisseurs of fine music—for those who want to hear and appreciate the difference between ordinary tape recordings and the fine professional recording and sound reproduction of the Concord 880.

Other important professional features of the Concord 880 include:

- all push button operation
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- sound with sound recording
- exclusive Concord computerized channel indicator
- three speeds
- built in monitoring
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The 880 includes two professional dynamic microphones in a compact unit perfect for use as a portable stereo recording and playback system—ideal as a permanent part of your hi-fidelity music system.

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if you're a connoisseur you'll hear the difference.
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CONCORD 880

CONCORD ELECTRONICS CORPORATION
809 North Cahuenga Boulevard, Dept. L, Los Angeles 38, California

re-do all the work, you're in a real nest of trouble. Unless, as I say, you are a professional. Or an advanced amateur with a cool, reasonable head on your shoulders and a tendency not to jump to conclusions. Not ever.

And so—we have balanced our home system. As any commonsense hi-fi fan knows, you do it the other way 'round from my account, which has followed the current, so to speak. (I know—alternating currents don't go anywhere. But we assume that the signal "travels" from pickup to preamp, and so on.) The way to do it is to check speaker balance first, then move back to power amplifier—all on a single signal—and then branch out into each and every pair of feeding circuits . . . but let's leave the whole thing lay. I'm working up a good headache just thinking about it.

So—assume your system is balanced, throughout. Let's just say it *is* balanced. And assume, too, that your identical speakers are in identical and complementary positions for an ideal acoustical balance. We then approach the delicate problem of balance-after-the-fact, i.e. balance in the incoming stereo signal. That's where I started. And it is where I will end. Because ten seconds' thought will convince you that there is no conceivable way in which one can check the balance of a stereo *recording* except by using one's own best guesstimate.

You say that so-and-so record of Haydn is all off-balance, because the left side is obviously louder than the right sides? I answer you that Haydn wrote for string orchestra and the violins do most of the musical work. Most of the time you'll find them on the left-hand side of the recording stage, where they belong. Of course the music is lopsided; it's supposed to be. You say, well, here's another record that has a full modern orchestra on it and the balance is dizzy—you can't ever seem to get the strings loud enough on the left side, and the brass and oboes and clarinets are too far on the right and too loud. Well, I say, you'd better ask the recording director or the man who put up his two mikes, or his three, or his several dozen. And then, when you've questioned him, go look for the control-booth technician with his fingers on all those pots, one for every mike and more for a "master" on each channel. He can throw the balance any old way with a half-inch turn and he can louse it up so thoroughly, too, that nobody from that point on can ever untangle it again.

Ah yes—and then there are the copyings, from the master tape, the blendings and "rebalancings" and the rebalancings of the rebalancings. And there are all the myriad tape heads, the preamplifiers in the dozens, the power amplifiers, the disc cutters and their amplifiers and their two halves, one for each final channel. All this, being professional, is surely above reproach. Of course, every element is balanced all along the line, with the utmost precision. That's what engineers and musical directors are hired for. That's what tens of thousands of dollars get spent on, and pounds and francs and schillings and guilders and yen and lire. *Of course* every respectable stereo record is properly balanced for playing on a balanced stereo system. . . .

And so my correspondent friend, if he is as benevolently cynical as I am, and as happy with stereo, will stop gnawing, and thereby promote more pleasure for himself. He'll know as well as I do that there never is and never will be a perfect stereo balance, that each little step forward merely crowns the pleasure of previous adjustments for "better" balance, and that, all in all, a good stereo record well reproduced is the darndest miracle that ever happened in

(*Continued on page 91*)

SUPERB REPRODUCTION OF DISC SOUND GUARANTEED

New Product

PROFESSIONAL TURNTABLE

PL-4

Pioneer, a well established manufacturer of audio equipment, has marketed a professional high-class stereo turntable, PL-4. Its superb characteristics have been achieved through constant research over many years by Pioneer.

Its motor, especially designed by Pioneer, is a 3-speed (33⅓, 45 and 78 rpm) hysteresis synchronous motor. The number of rotations is kept constant even if the voltage and load are changed. Moreover, due to the good dynamic balance of the motor and the adoption of a high precision and heavy diecast turntable, wow and flutter are reduced to a minimum.

The tone arm, which uses a 12 inch light alloy pipe arm, has no mechanical resonance at all. Its tracking error is reduced to a minimum, tracing faithfully with tracking force of 3 – 4 grams. Thus it is designed to satisfy all requirements of a tone arm. This arm can be lifted from and placed on any part of a disc by operating the lever on the deck of the turntable, thereby eliminating the need to touch the arm itself.

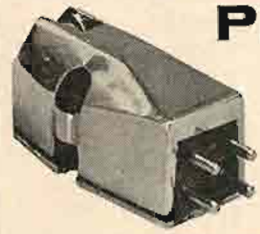
The cartridge of PL-4, which plays a vital role in determining the tone quality, is a newly designed, high-quality, moving magnet type cartridge, Model PL-C1. You can, of course use any cartridge of your own choice.

Specifications

Motor:	4-pole hysteresis-synchronous motor
Table platter:	12-inch diecast
Turntable-changer:	3-speed: 33⅓, 45, 78 rpm
Wow:	Less than 0.17 ± 0.05 per cent
S/N ratio:	Over 47db
Arm:	Professional pipe-arm

Specifications

Cartridge (PL-C1)	Moving magnet type with a 0.7 mil diamond stylus
Frequency response:	20 – 21,000 cps
Channel separation:	Over 20db (at 1,000 cps)
Power output:	5mV (at 1,000 cps 5cm/sec)
Impedance:	1.5k (at 1,000 cps)
Compliance:	4×10^{-6} cm/dyne
Tracking force:	3 – 4 grams
Tracking error:	± 1°



PL-C1

Moving Magnet Stereo Cartridge

This is used in the turntable PL-4, but also can be used in all kinds of professional tone arms. Its frequency range is as wide as 20 – 21,000 cps. Moreover, it has a superb channel isolation in the higher range. These superior qualities combine to produce superb stereo effects. A unique cantilever is used to reduce the mass of its vibrations system, and at the same time a high compliance is maintained. Thus, with a light stylus pressure, beautiful and rich stereo sound is assured.

PIONEER

PIONEER ELECTRONIC CORPORATION
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EDITOR'S REVIEW

HIGH FIDELITY STANDARDS

Recently there has been a flurry of excitement caused by the announced intention of the Federal Trade Commission to discover and establish a set of standards whereby high fidelity equipment may be categorized. Frankly we are definitely in favor of any move to clear up confusion and eliminate false advertising statements. On the other hand we are rather doubtful that valid standards would result in view of the present stage of development of high fidelity.

For instance, starting from the premise that the primary purpose of high fidelity equipment is to reproduce music as faithfully as possible, we must first determine how we will know when music is being faithfully reproduced and under what circumstances. The significance of the first point is that at present there is only one final test instrument which is valid in determining the quality of a music reproducing system—and that is the human ear. Stated negatively, there is no existing set of instruments which can tell in advance whether a particular system will reproduce music faithfully for a particular person. Compounding this problem is the inevitable influence of location on the ultimate sound. Thus it is possible to conceive of a situation wherein a particular system may sound very well in a small room, and not very well in a large room.

Again, going back to our original premise, it is clearly possible to determine whether a system is *very* bad or just plain bad; most people who have listened to live music can discern highly distorted reproduction. On the other hand we would venture to say that only a handful could offer an intelligent opinion as to the difference between good, very good, and excellent. And, as has been demonstrated many times, the handful would not agree amongst themselves. Thus, if we are to set up standards based upon the "expert ear," and the experts cannot consistently agree as to which is good, very good, and excellent (isn't this the exact area occupied by high fidelity equipment?) of what value are the standards? This leaves us exactly where we started—with a broad category which is subdivided further by personal preference. In essence, our point is that the very bad equipment is easily discernible, and the rest is a matter of subjective judgment.

Considered from another viewpoint, this attempt to legislate high fidelity has some serious pitfalls. First of all, since the area of high fidelity reproduction encompasses a degree of personal taste, we feel that this is an area which would best be avoided by governmental agencies. We are sure everyone would be up in arms if the government were to attempt to establish standards of "good music." We feel that trying to set "standards" for high fidelity reproduction is really in the same category.

Of course the purpose of this procedure on the part of the FTC is really to protect the consumer from fraudulent representation, and again we are wholly in agreement with this purpose. It is our belief, however, that the purpose could be accomplished by less dangerous means than trying to establish taste standards. We won't go into the specifics of "less dangerous means" at this time, but we are convinced that there is a valid answer and will devote some time and space to it in the future. What are your thoughts?

While we are on the topic of "standards," we note that concurrently with (but not necessarily related to) the move by the FTC, a paper was presented before a group of professionals in the loudspeaker industry. In this paper a system was proposed that loudspeakers would be color coded in a manner similar to resistors in order to indicate some of the speaker characteristics and the "quality." Again we are in opposition to the idea of "quality" standards which of necessity must include a degree of taste. On the other hand we consider the proposal to label speakers in certain operating characteristics (such as frequency range and acoustic power-producing capability), as determined by standard tests, to be an excellent idea. The point that we find particularly important is the standardization of measurement conditions. In essence, by providing the consumer with a valid source of information, we are giving him a tool whereby he may now exercise informed judgements if he so desires. To us this is much more to be preferred than telling the consumer what is good or bad.

We must admit that this proposal (by Lincoln Walsh) has much merit, and that even his "quality" rating scheme has more science than most we have encountered. However, like other proposals in this category it founders. An example may illustrate just how.

In the Equipment Profile section this month a speaker system is reviewed which has a very flat response, plus other excellent characteristics. Most likely, by the standards of quality outlined by Mr. Walsh, it would rate as a very fine system. Equally likely, many people would not be convinced that it was a very fine speaker system because of its flat frequency response. As mentioned in the review, it is an unfamiliar sound to people who have been "sound conditioned" by theatre sound, or table radio sound, or television sound, or school auditorium sound, or a combination of all these sources. We recall the first time we ever heard a speaker system meant for European ears. Frankly it was quite puzzling; apparently Europeans are not as interested, or weren't then, in reproducing the bass as fully as we are, or were then, in the United States. At that time it became obvious to us that the European "standard" for high fidelity reproduction was different than ours. Obviously then, if we were to rate European speakers by the standards proposed by Mr. Walsh we would arrive at a different answer than most Europeans would arrive at. Possibly the answer would be different than many of us would arrive at.

ANOTHER EVENT

Last month, when we listed the roster of coming events of interest to the audiofan, we missed out on an event of importance to our *Canadian contingent*: the High Fidelity Music Show in Montreal. Be informed that it will take place from October 9–13 and the setting is the Sheraton Mount Royal Hotel. We will be represented at this show so please come by and say hello.

*Throughout the entire world... more people listen to stereo records reproduced by the STANTON Stereo Fluxvalve than any other magnetic pickup!

*__More__ stereo records are quality controlled and reviewed by professionals using STANTON Stereo Fluxvalves.

*__More__ high quality phonograph consoles use STANTON Stereo Fluxvalves than any other magnetic pickup.

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And now...new dimensions for stereo from the world's most experienced manufacturer of magnetic pickups–

STANTON 481

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Model 481AA STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with ultra-lightweight tone arms capable of tracking within the range from 1/4 to 3 grams. Supplied with the D4005AA V-GUARD diamond stylus assembly.
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Model 481A STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with manual tone arms, recommended tracking force is from 2 to 5 grams. Supplied with the D4007A V-GUARD diamond stylus assembly.
AUDIOPHILE NET PRICE **$48.00**

Model 481E STANTON Stereo Fluxvalve Set—same as the Model 481A but includes two additional V-GUARD styli: the D4010A 1 mil for LP's and the D4027 2.7 mil for 78's.
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STANTON 400

Professional Stereo Fluxvalve*

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AUDIOPHILE NET PRICE **$39.00**

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*The hermetically sealed STANTON Stereo Fluxvalve is warranted for a lifetime and is covered under the following patents: U.S. Patent No. 2,917,590; Great Britain No. 783,372; Commonwealth of Canada No. 605,673; Japan No. 261,203; and other patents are pending throughout the world.

High-Stability Feedback Amplifier

ARNOLD J. KAUDER*

Conservatively designed, but with performance of the highest caliber, this amplifier should easily become the standard of reference for the builder who wants to go all the way himself, yet who demands professional or laboratory quality.

The achievement of adequate stability is still a major problem in the design of feedback amplifiers. The writer became aware of this problem after work with amplifiers which developed shorted output tubes, or blew fuses or transformers when operated with no load for any appreciable interval. Other amplifiers were observed which produced "scratchy" sound due to overbias resulting from high-frequency oscillation when connected to capacitors used in dividing networks from multiple loudspeaker.

Investigation of this problem resulted in the amplifier described in this article which was developed after many months of study, design, and testing. The amplifier is perfectly stable with no load, with any capacitor up to at least 40 µf as a load, and with or without loudspeakers or load resistors or combinations of these elements. One channel has been loaded with a 40-µf capacitor, the other channel has been left unloaded, for a solid week of operation without any indication of instability or damage.

Design Specifications

The following set of specifications was set up as a goal for the design of the Kauder amplifier:

1. Complete stability with any type of load ever likely to be employed.
2. High feedback factors—at least 20 db of feedback at all frequencies down to 20 cps, where the distortion-reducing effects of feedback are most needed, and up to 10,000 cps, the highest frequency with harmonics in the audible range. Most "20-db" amplifiers have very much less than 20 db of feedback at these frequencies—10 db or even less is not uncommon.
3. Output of 20 watts per channel (40 watts total power) with simple provision for increase to 40 or more watts per channel if desired. 20-watt output is obtained at an input of approximately 0.9 volts.
4. Flexibility—ready adaptability to any type of output stage.
5. Sensitivity of about 1 volt rms input for full output.
6. Very low distortion, noise, and hum.
7. Moderate power consumption with respect to power output to provide relatively cool operation in the user's equipment cabinet.
8. Attractive appearance and ease of assembly.

These "dream" specifications have all been met or exceeded, although there were times when the author put the whole idea and equipment out of sight and vowed never to touch the "beast" again. See *Figs*. 1, 2, and 3 for views of the amplifier.

Configuration of Amplifier

The final design employs a pentode Class AB output stage, a cathode-coupled triode driver/phase-inverter stage and a pentode input stage in an arrangement basically similar to the British-made Leak amplifiers. The classic combination of two wide-band stages and one narrow-band stage is used with the input stage narrow-band to avoid overloading subsequent stages with frequencies outside their pass band.

The over-all feedback loop has just over 29 db of negative feedback at mid-range, with 27.5 db still in force at 20 cps and 24.5 db at the very low frequency of 10 cps. At high frequencies, feedback is 20 db or more to 15,000 cps, dropping to 18.5 db at 20,000. Additional feedback of about 10 db in the input stage and 6 db in the driver stage provide further distortion reduction over the

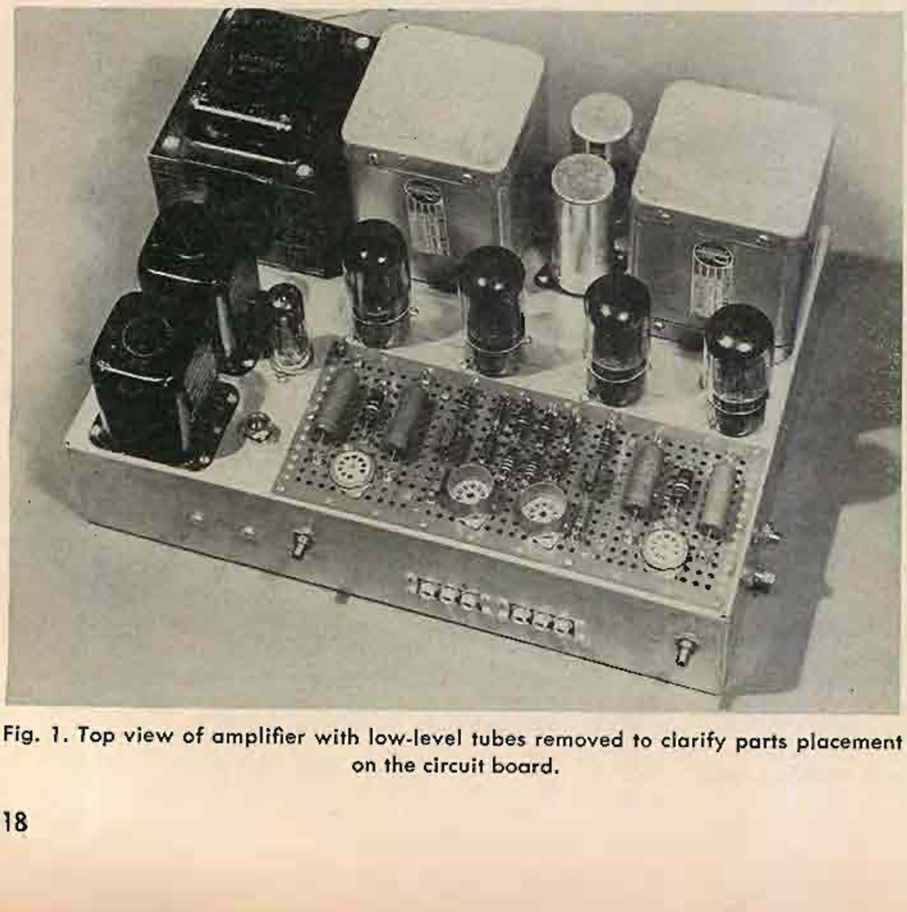

Fig. 1. Top view of amplifier with low-level tubes removed to clarify parts placement on the circuit board.

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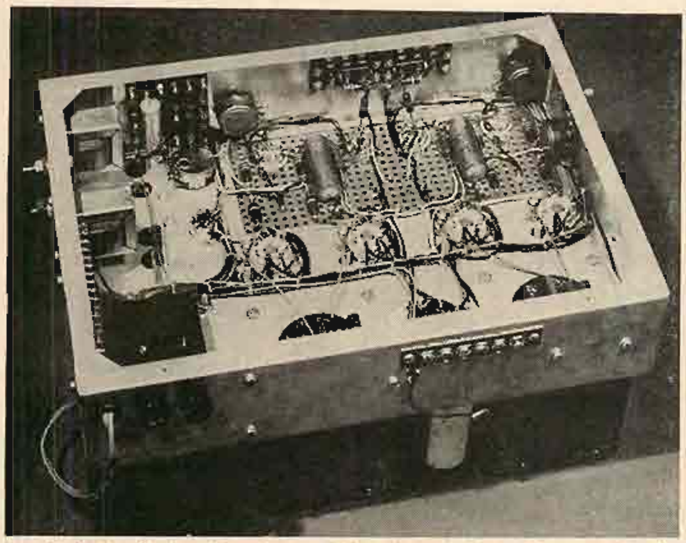
* *448 N. La Jolla Ave., Los Angeles 48, Calif.*



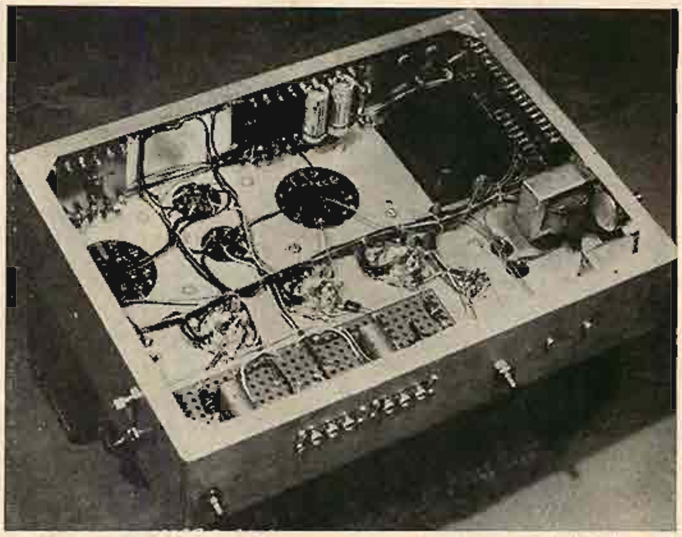


Fig. 2 (left). Underside view of the chassis from the rear to show wiring and right end flange of chassis. Fig. 3 (right). View of chassis from opposite corner from Fig. 2.

complete frequency range of the amplifier.

Some designers would say that this amplifier has 45 db of feedback (29 plus 10 plus 6) but this will be left to the judgment of the reader as far as the author is concerned.

Stabilization is ensured by phase correction and controlled attenuation provided by two networks—shunting the output transformer and the other shunting the plate load of the input pentode stage—and also by the reaction of the internal feedback loops in the input and driver stages with the main loop.

Design of Individual Stages

1. Output Stage (see *Fig.* 4 for Schematic.) Two 5881 pentodes are used in each output stage and easily meet the requirement of 20-watt power output in Class AB operation with plate voltage of 360, screen 270, and a bias of – 22.5 volts in fixed-bias operation. Plate current with no signal in 45 ma per tube, or 180 ma for all four output tubes. A major factor in the low distortion of the output stage is regulation of the screen supply by a twin triode, 12BH7 in a simple cathode-follower circuit.

The output transformer is a Peerless type S258Q, rated at 40 watts. The rated impedance of the primary is 5000 ohms, but at all frequencies outside the midrange the impedance of loudspeakers is likely to be much more than their nominal 16, 8, or 4 ohms and this transformer impedance probably is a better compromise at low and high frequencies than the tube-manual value of 6600 ohms. Measured output power *with resistance* loading at midrange will be somewhat less, but may actually be more at frequencies well removed from 400 to 1000 cps with the usual *speaker instead of a resistance load.* The S258Q transformer has 50-per-cent taps for screens, but the high efficiency of the pentodes provides power output just not available from the screen-tapped circuit at comparable supply voltages. The author's study indicates that the best amplifiers encountered use only *token screen taps* at 10 per cent of the transformer primary and are essntially pentode operated. For those who prefer triode or ultralinear connection of the output tubes, revision of the amplifier to accommodate such operation is discussed later.

Those who need higher power output may use type 6L6GC or 7027 tubes with plate voltage of 450 and screen voltage of 350, and with a grid bias of – 30 volts. Power output of as much as 50 watts is available from a pair of either type operated at the indicated electrode voltages.

Measurement of the frequency response of the output stage alone showed that it was down 1 db at 10 cps and 140 kc, equalling the catalog figure at low frequencies and far exceeding the figure for high frequencies as used in the pentode output stage. The 3-db-down frequency was calculated as 1.7 cps, since the equipment at the writer's command did not generate frequencies below 5 cps. The corresponding 3-db-down high frequency was measured as 180 kc.

The parallel-resonant high frequency of the transformer was found by shorting the secondary terminals and checking with an audio oscillator and oscilloscope for a peak developed across the primary. This peak was found at 128 kc. The leakage inductance and equivalent shunt capacitance of the primary winding were now determined by shunting a large tuning capacitor across the primary and varying the capacitance until resonance occurred at half the previous frequency or 64 kc. This occurred

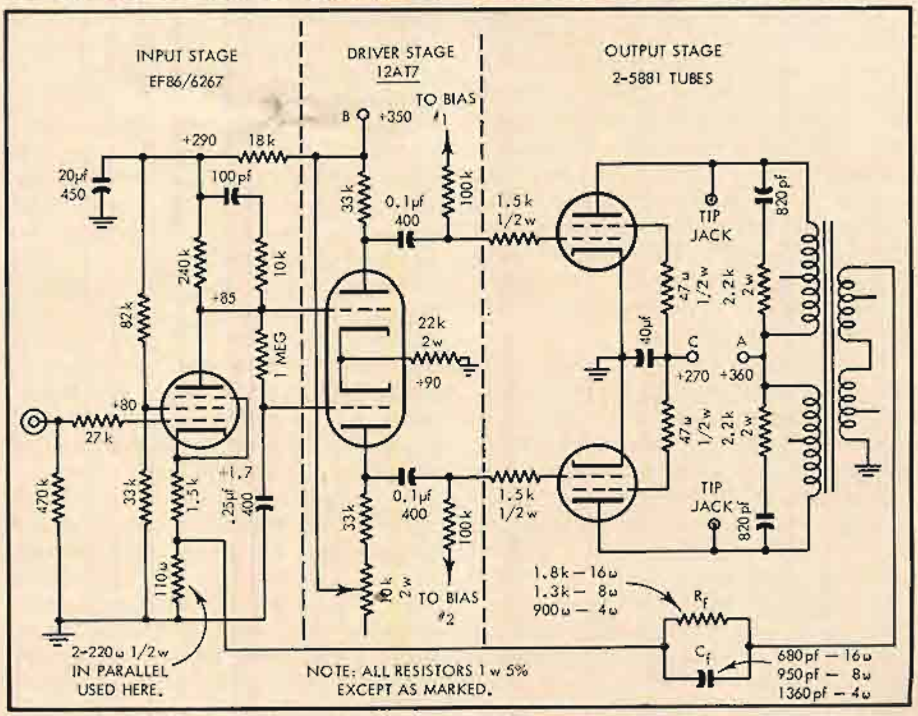


Fig. 4. Schematic of the amplifier section. Power supply is shown in Fig. 5.

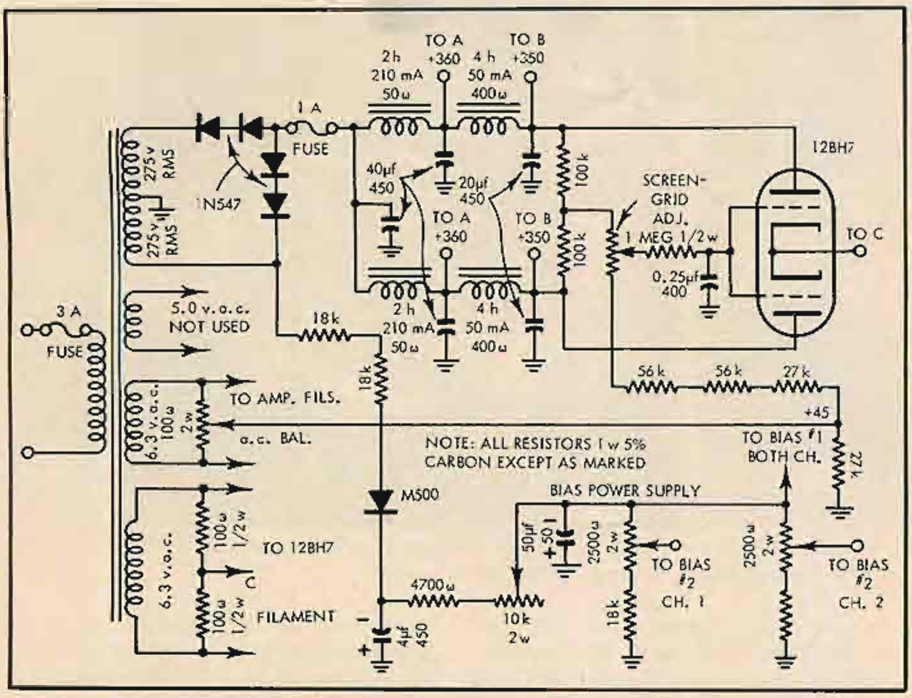


Fig. 5. Schematic of the power-supply section.

with a measured capacitance of 900 pf which may be shown to be three times the internal equivalent capacitance of the transformer, or 300 pf. The leakage inductance of the transformer can be computed from the relationship for L, C, and frequency, $f = 1/(2\pi\sqrt{LC})$ for either capacitance and is about 5 mh.

A resistor-capacitor network is connected across each half of the output transformer to suppress a peak in the output at the parallel-resonant frequency which would otherwise cause oscillation as the feedback was increased to the high level used in this amplifier.

This network should have a resistance with a value equal to about 40 to 50 per cent of the transformer plate-to-plate impedance and a capacitance between two and three times the equivalent plate-to-plate capacitance. Values finally chosen as optimum for the writer's amplifier were 2200 ohms and 820 pf, selected on the basis of best square wave reproduction of 10,000 cps. With the networks installed, the response of the output stage was found to be down 3 db at 80 kc instead of 180 kc.

2. *Phase-Inverter/Driver Stage.* This stage employs a type 12AT7 twin triode in a cathode-coupled circuit. How this tube has been so consistently overlooked in the cathode-coupled phase inverter is a mystery to the author, for its high mutual conductance and low plate resistance with the resulting high amplification factor enable reasonable amplification to be obtained with low-resistance plate loads and consequently extended high-frequency response. Circuit balance is far better than that with tubes such as 12AU7 and 6SN7 between the two halves of the tube and about twice the gain is obtained with the same load resistance.

The measured high-frequency response of the 12AT7 with a common cathode resistor of 22,000 ohms and plate load resistors of 33,000 ohms is down 3 db at 180 kc. A variable resistor is provided in series with the plate load of the cathode-driven triode to enable signal balance to be obtained at the plates of the output tubes. The resistance of the pot is 10,000 ohms but could well be as little as 2000 ohms if the two 33-k resistors are matched. The gain of this stage is slightly over 20.

Two factors in the assembly of this stage require careful consideration. First, the capacitor from the grid of the cathode-driven stage to ground must have extremely low leakage, or very serious unbalance and distortion will result. Second, the grid of the other section must be wired with the least possible capacitance to the plate circuit of the cathode-driven section or troublesome regeneration may result. Early in the design the writer was considerably troubled by a peak in the over-all amplifier response at about 55 kc. After much checking and many measurements this peak was traced to coupling caused by running the grid lead of the grid-driven section too close to the plate wiring of the other section of the tube. Rerouting the wiring cleared this fault.

The output resistance-coupling circuit of the driver stage has a cutoff at low frequencies at about seven times the corresponding frequency of the output stage, being down 3 db at 12 cps. Since, as will be shown, the input stage has no elements producing phase shift at low frequencies, this moderate staggering of the time constants provides not only complete stability, but enables a very high feedback factor to be obtained at even 10 cps and lower.

3. *Input Stage.* The input stage is the narrow-band stage, with high-frequency response controlled by an RC network shunted across the plate-load resistor of the tube. This network changes the impedance value of the load considerably with increasing frequency. Since a pentode tube is not sensitive to variations in its plate load, it was used in preference to a triode. An EF86 low-noise pentode was chosen for the input stage with its excellent internal shielding being the deciding factor between it and other low-noise tubes. The shielding is so good in this tube that it is completely unnecessary to use tube shields, as is shown in the pictures of the author's amplifier.

As the feedback factor is increased in any three-stage amplifier, a low-frequency peak will appear. The methods used to avoid oscillation have been: (a) to stagger the time constants, with some amplifiers even containing massive 1.0-μf capacitors in one stage and tiny ceramics in another, and (b) to use step networks consisting of parallel resistance-capacitance networks to attenuate the only-too-often marginal low-frequency gain of the amplifier. Not only do these devices seldom eliminate completely the undesired low-frequency peak, but also they reduce the value of feedback at the low frequencies where it is most needed.

If the peak at low frequencies is not eliminated it may cause "breathing" of the speaker cone with no input signal and a muddy low-frequency sound, as has been observed in a number of so-called "Williamson Type" amplifiers.

The author has learned to beware of amplifiers whose response curve shows only frequencies down to 20 cps and terminating with a slight rise. This rise will often lead to a peak below 20 cps with the amplifier overloading and producing an annoying boom whenever a bass drum or other instrument produces sound at very low frequencies in the signal fed to the amplifier input. Such peaks show up on a square wave test of amplifiers as a spike or peak on or near the leading edge of the amplifier output waveform, which does not concur with any theory known to the author. After many trials the writer realized that if the input stage were direct-coupled to the driver stage and if all bypass capacitors were eliminated from the first stage, complete stability could be obtained and with a very high feedback factor at that. The amplifier may be considered a two-stage amplifier for low-frequency feedback stabilization and it is only necessary to stagger the time constants of the driver and output stages as previously described to achieve complete stability. Phase shift in a two-stage amplifier becomes 180 deg. only as the gain falls to zero and oscillation is then not possible.

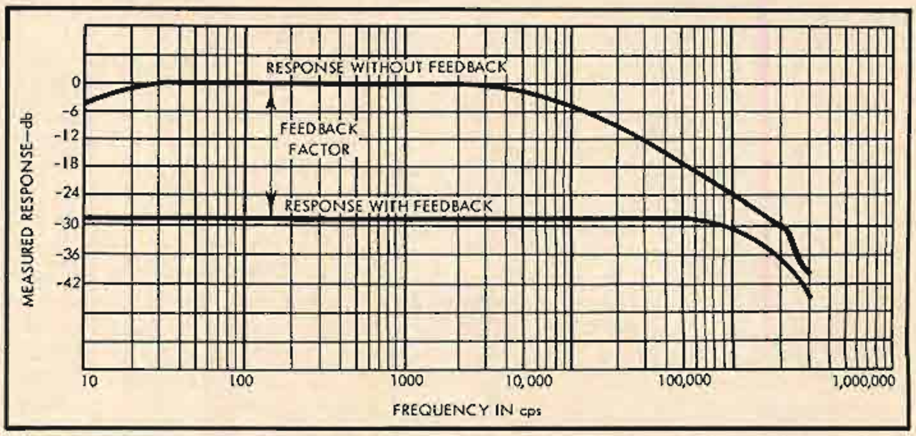


Fig. 6. Frequency response of the amplifier with and without the main feedback loop connected.

The screen of the EF86 is fed from a voltage divider drawing about ten times the screen current, which is enough for good stabilization. Cathode bias is provided by a 1500-ohm resistor and a 100-ohm resistor in series without any bypassing capacitor.

The measured gain of this first stage is 65, compared with about 200 with complete bypassing, a reduction of about 10 db, but this loss is considered a good investment in obtaining the complete low-frequency stability and remarkably high feedback factor at even such a low frequency as 10 cps.

High-frequency stability of the amplifier is largely dependent on control of the high-frequency response of the input stage by a step network made up of a 100-pf capacitor and a 10,000-ohm resistor shunting the plate load (240,000-ohm plate resistor and 1-megohm grid resistor of the driver stage in parallel). Response is down 3 db at about 8000 cps since the reactance of a 100-pf capacitor equals about 200 k ohms at this frequency. The ultimate attenuation of this network is 20 (26 db) and attenuation is 3 db less or 23 db at 160 kc, since the 100-pf capacitor has a reactance of about 10,000 ohms at this frequency.

The unbypassed elements in the first stage provide corrective phase shift which operates in conjunction with the over-all feedback loop to ensure a very high level of high-frequency stability. The combination is a form of Duerdoth's[1] method of achieving stability.

Throughout the frequency range of 5 cps to 300 kc, the Kauder amplifier has shown no indication of regeneration, which is another way of saying that the response with the main feedback loop closed is never greater than the response with the loop open. This can be said of few amplifiers with even 20 db of feedback in the midrange.

Power Supply Design

The power transformer is a surplus television type, rated at 250 ma, with high-voltage winding providing only 275 volts each side of the center tap. Two 600-volt PIV Transitron silicon diodes, (type 1N547), are used as rectifiers on each side of the transformer high-voltage winding and provide 360 volts d.c. at the output of the first choke, which has a resistance of 50 ohms. This is about 40 more volts than can be obtained from type 5V4 tubes and about 80 more than type 5U4G tubes will provide. The power supply schematic is shown in *Fig*. 5.

Regulation of the plate supply is very good, since the only factors causing a drop in voltage at high output are the resistances of the transformer and the filter chokes.

The writer has used two filter systems to isolate the two amplifiers because in his household there are times when one channel is used to play the ball game on a remote speaker while he listens to music through the other channel. The two channels have been operated with the two filter systems connected in parallel with no audible hum. The writer will always use at least one choke in the B supply of his amplifiers, but realizes that his insistence on hum being inaudible at more than one foot from the loudspeakers is on the idealistic side.

A type 12BH7 twin triode operated from an extra 6.3-volt winding on the power transformer is used to provide regulated screen voltage for the power output tube. If the power transformer used by the author were not provided with an extra 6.3-volt filament winding, he would have used a type 5BQ7 or 5BK7 twin triode to provide regulated screen voltage for the power output tubes, since the 5-volt rectifier-tube filament winding is available when silicon rectifiers are used instead of tube-type rectifiers. This procedure is suggested to prospective builders.

Negative bias is supplied by a single silicon rectifier, with peak inverse voltage problems solved by the use of a series dropping resistor to reduce PIV within the limits of a Sarkes Tarzian M500 clip-in rectifier, a 400-volt PIV unit. A two-stage filter is employed with a variable resistance enabling adjustment to the desired level of −22.5 volts. Another variable resistor permits balancing the idling currents of the output tubes in each channel.

Measured Performance

The frequency response of the Kauder amplifier is shown with and without the main feedback loop connected in *Fig*. 6. The response with feedback is down 1 db at 5 cps and at 70 kc. High-frequency response is down 3 db at 120 kc and 14 db at 300 kc. Experienced designers will recognize the inherent stability in the smooth roll-off at high frequencies, and the lack of any rise at low frequencies.

The feedback factor is, of course, the difference in amplitude of the two curves and is seen to be 29 db at midrange, 27.5 db at 20 cps and 24.5 db even at 10 cps. At 15,000 cps the feedback factor is 20 db and falls to 18.5 db at 20,000 cps.

As should be expected with such high feedback factors, the distortion is extremely low, being in fact limited only by the balance obtained in the output tubes. The amplifier has been found to deliver 16 watts of equivalent-sine-wave power with 0.1 per cent intermodulation distortion and 22 watts at 1 per cent intermodulation distortion. Harmonic distortion is well below 1 per cent at the 20-watt level set as a goal by the author, who regards harmonic distortion measurements as of minor significance compared to intermodulation tests, since it is felt that intermodulation distortion becomes preceptible at a much lower level.

An output of 20 watts per channel is more than the writer can possibly use with his three-way speaker system designed around a Stephens speaker no longer available as the woofer, but he has no quarrel with those who feel the need of 50 or more watts per channel. However, at least one owner of two 60-watt amplifiers has offered to trade them for the author's single stereo amplifier—and for use with low-efficiency speakers at that. The test equipment used consisted of a Hewlett Packard Model 200CD Audio Oscillator, several Tektronix and Dumont Oscilloscopes, and a Heath Audio Analyzer, calibrated against laboratory standards. Square-wave tests were made with an instrument of the author's own design, which he hopes to find time to describe in a future article.

Transient Performance

The square-wave reproduction is easily the best the author has ever seen, either on amplifiers he has checked or in published reports. *Figure* 7 shows the reproduction of a 50-cps square wave. There is little tilt, confirming the reproduction of frequencies down to below 5 cps. The absence of any spike or peak on the leading edge indicates that the response does not have any sharp peak or rise in the critical region below 5 cps. The reproduction of 1000-cps square waves differs so little from the signal source that there is little point in picturing it. *Figure* 8 shows the reproduction of a 10,000-cps square wave, with a very slight trace of ringing which is quickly damped out. Optimum values for the components in the network shunting each half of the output transformer and the capacitor shunting the feedback resistor are needed to achieve this performance.

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[1] W. T. Duerdoth, *Proc. I.E.E.*, Part III. 97.47 (May, 1950) 138.

Physical Construction

The chassis is 10 by 14 by 3 inches, which results in a compact layout, but provides adequate room and good ventilation to meet the stated requirements. The output transformers are mounted with the center line of their cores in line with that of the power transformer, but the cores are at right angles to that of the power transformer. This provides zero hum as may be readily chacked with the power transformer connected to the a.c. line and an oscilloscope connected to the primary of the nearest output transformer. Spacing washers are used under the mounting threaded holes and screws to raise the transformers slightly above the chassis to permit air circulation. Chokes are oriented in the same manner, but are not at all critical in this unit, probably due to their relatively small inductance. Mounting holes for the power output tubes are punched about one-eighth inch oversize and spacing washers used below the chassis to allow air circulation to promote further cooling.

The input and driver stages are mounted on a Seezak prepunched bakelite board, cut to a length of 9 and ¾ inches, for which a cutout in the chassis is made. The board has an output capacitance after completion of the wiring considerably lower than that of conventional layouts and is in no small part credited with the wide-band response of the phase-inverter stage. It was initially planned to make up a printed circuit board or use a new chassis for the final amplifier, but so many favorable comments have been received on the appearance that the construction is not likely to be changed. A worthwhile revision may be to mount the board on ½ inch or longer spacers below the chassis to prevent contact with "hot" leads. These boards are highly recommended for experimental construction—at least two thirds of the now unused holes had terminals mounted in them as the author revised the design of one channel and tested it for comparison with the other, yet the final design looks fresh and neat.

The writer has been contacted by two electronics firms interested in fabricating printed circuit boards, however, and it may be that such boards will be made available if sufficient interest develops.

The wiring of filament and plate-supply leads is cabled, with different colors used to identify the leads, starting with red for the highest voltage, orange for the next, then yellow and so on to black for ground wires. All ground leads are isolated from the chassis except at the input terminals. Filter capacitors are mounted on fibre or Bakelite plates, each being a 40–40–20–20–mf unit at 450 volts.

The layout is believed to be extremely efficient, with parts so well placed that lead lengths are as short as possible, circuit capacitance is the absolute minimum and undesired coupling just "ain't." The triple input jacks are provided for an attenuator or rumble filter if desired at some future date.

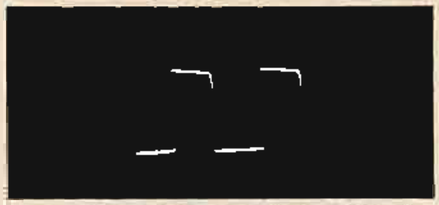
Fig. 7. Square-wave response of the amplifier at 50 cps.

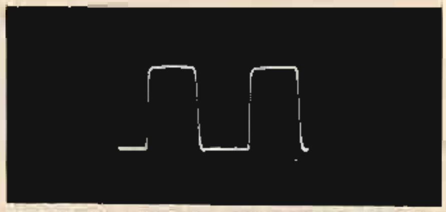
Fig. 8. Square-wave response at 10,000 cps.

The voltage divider and grid filter for the screen-voltage regulator tube are mounted on a terminal board on the left front flange of the chassis, as seen from the topside. The silicon rectifiers are mounted on a terminal board under the power transformer on the left chassis flange. This board also contains two 18,000-ohm resistors used in series with the bias rectifier. The rectifier and the associated filter components are mounted on a terminal board on the right rear chassis flange. The a.c. balance pots are mounted on the front chassis flange. The top mounted pot is the screen regulator tube adjustment used to set the screen grids at +270 volts. The bias-adjust pot and the d.c. balance pot for the right channel are mounted on the right side of the chassis. The other d.c. balance pot and the filament hum-balance pot are mounted on the left side flange of the chassis. Although some deposited carbon resistors are shown in the photographs, their use is not required. Noise in the amplifier as well down in the residual figure of an a.c. VTVM with a full-scale reading of .01 volt.

Balancing Adjustments

Balancing of the amplifier is carried out as follows: The bias-adjust pot is set to provide 22.5 volts at the output of the bias filter. The screen-adjust pot is set for 270 volts; then a VTVM or VM is connected to the tip jacks at the plate terminals of one channel and the d.c.-balance pot for that channel is set for equal drop across the plate windings of the output transformer. The output tubes may require interchanging to achieve balance. The transformer must have symmetrical windings of equal resistance for this method of balancing, but this is true of all high-quality transformers the writer has checked. A.c. balance is best set with an intermodulation meter, but may be set by adjusting the a.c.-balance pot with a VTVM for equal outputs (at about a 100-volt signal level) at the plates of the two output tubes.

Design Variations

It is rather obvious that no expense has been spared in the material used in this amplifier. Those prospective builders too wise to give up shoes for ceramic sockets and extra filter chokes should be interested in a simpler version, providing fine performance at lower cost.

A design employing a single choke or even resistance-capacitance filtering as in the stereo amplifier presented by C. G. McProud in the August, 1958, issue of AUDIO, should give fine performance at greatly reduced cost. Self-biased operation of the output stage with low loading as outlined by L. B. Dalzell in AUDIO for December, 1959, would provide further cost reduction with performance on music equal to fixed-bias operation as far as the listener is concerned. Steady-state power and distortion measurements would indicate more distortion than is present under actual listening conditions, however.

If self bias is employed, the output of the plate supply should be increased to provide an additional 22.5 volts to maintain 360 volts between the plates and cathodes of the output tubes.

The author is of the opinion that the input and driver stages of his amplifier are very nearly universal and can be used with either triode or ultra-linear output stages. Since higher plate-supply voltages will be required for any change from pentode operation, the plate-load resistors of the driver stage can be increased to obtain additional gain to make up the loss suffered in changing to triode or screen-tapped output stages. Tapped output transformers may be found with multiple resonances, as shown by N. H.

(*Continued on page 98*)

The Hamograph, A New Approach to Electronic Music

The Hamograph produces electronic music by means of shaped and spaced metallic surfaces on variable-speed film to control amplitude, duration, attack, and decay of a given tone.

J. W. BERRIDGE[*]

THE RAPIDLY INCREASING growth of audio in its various forms is producing some intensely varied machinery, but none of it more varied than the equipment which is being born of the studies of electronic music labs the world over. Such a piece is the Hamograph, developed by musicologists of the Faculty of Music, University of Toronto. However, before I launch into a description of the machine itself it might be better if I sketched in a little of the history of electronic music.

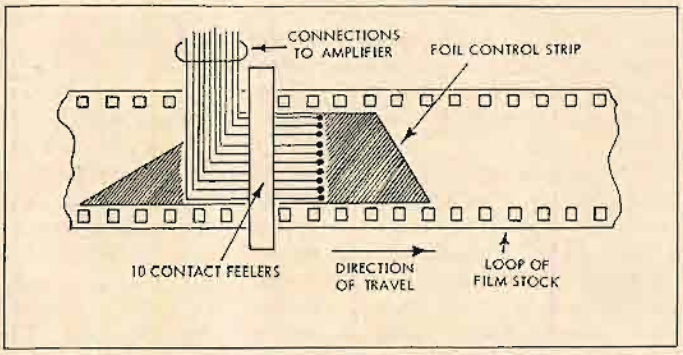

Fig. 2. How the foil control strip shorts out the appropriate contact feelers.

Same History

As an art form, this type of music is *not* new. As early as the end of the last century, Thaddeus Cahill of Iowa developed a rotary generator which was basically the forerunner of the tone-wheel system used in some electronic organs. Lack of any form of adequate amplification at that time prevented his device from becoming practical. The Novachord, developed much later, used twelve vacuum-tube oscillators to give a complete chromatic scale. Another possibility was explored in 1924 by the Russian scientist Theremin who used two oscillators to produce a beat frequency and varied this frequency by varying the physical separation of the oscillators. As a one-note instrument, that required considerable practise to produce even a simple scale (with all transitions a glissando), the Theremin has never got beyond the novelty stage.

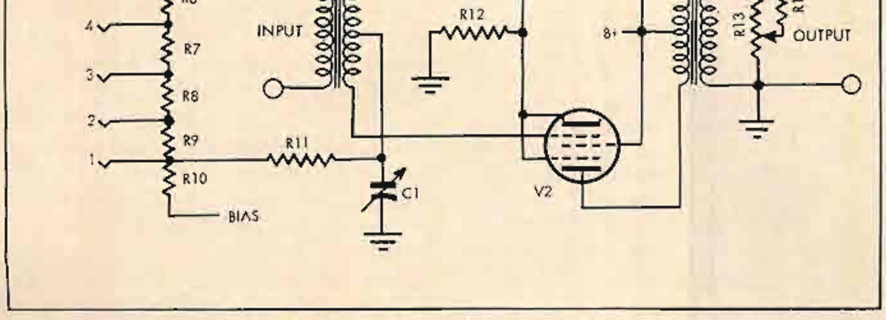

Fig. 1. Schematic of one of the control amplifiers.

On the other hand, the electronic organ has become so popular and versatile that it's no longer regarded as anything other than a conventional musical instrument. Another instrument, the Studio Trautonium, was used very successfully by Remi Gassman for his ballet "Electronics" which was performed in New York in 1961.

Aside from more recent commercial aspects of electronic music (TV commercials in particular) and science-fiction movies ("Forbidden Planet" used an all-electronic score to good effect), various composers have used different approaches in their efforts to explore the scope of musical sounds. Some individuals even bang away at assorted objects at random and call it "music." While their efforts are praiseworthy if carried out with a sense of proportion, I can't help observing that a good rush-hour traffic jam has often been known to produce similar results!! (*There are some people who love the sounds of a traffic jam.* ED.)

Varèse and Honegger have both used conventional instruments to explore unconventional and exciting ideas ("Ionisation" and "Pacific 231" to quote just two). Luening and Ussachevsky have composed several pieces for tape recorder and orchestra, with the recorded parts produced by tape manipulation. Karl-Heinz Stockhausen and Pierre Shaeffer have each used manipulation of everyday sounds to produce what has

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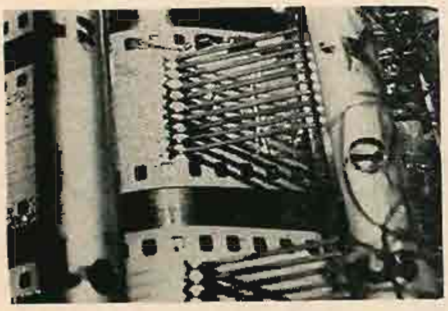


Fig. 3. For each track there are ten contact feelers, made of silver for good contact. Film travel in this photograph is from left to right.

come to be called "Musique Concrète." The Dutch composer Henk Badings recently presented a serious science-fiction opus called "Salto Mortale" ("Death Leap") for the Netherlands Television Service, a pioneering electronic work marred somewhat by a space-opera approach on the part of the program directors.

All this and much more is an extension of a trend in the last 150 years to develop certain instruments and techniques for effect rather than musical contribution. Certainly neither cymbals nor tympani have any musical values as such yet they carry a great deal of emotional impact. Composers in a number of electronic music studies have dropped the probing-at-random approach and are now systematically exploring and expanding the possibilities of music as we already know it, using electronics to add a wealth of further experience to present musical knowledge.

The Hamograph

This instrument is the offspring of several lines of approach. Tape editing and manipulation, while offering a great deal of scope for experimentation, rapidly become tedious and limited if a researcher probes very deeply into the characteristics of a given sound. To the composer who assembles music a note at a time by tape editing and dubbing, any fast tempo is exceedingly difficult and a pizzicato effect almost impossible. A single "plink" occupies so little tape space as to be unusable, and unless highly tedious and unpredictable editing techniques are used, the only attack and decay characteristics possible are very short. Added to this is the fact that for a researcher to repeat previous results he must either assemble the whole thing again or indulge in several generations of re-recording with noticeable loss of quality. Even then there are the limitations imposed by the pitch and tempo of the original. These can be changed but not independently (within feasible limits that is).

Now there *are* five important characteristics to a sound if it is to be used musically. They are amplitude ("intensity" if you prefer it), duration at that amplitude, attack, decay, and quality. The latter covers both fundamental frequency and overtone characteristics and presents less of a problem to the researcher than do the other four. Quality can be governed electronically with almost infinite variations, and it also tends to remain unaltered for at least several notes in the majority of compositions.

The Hamograph is *not* a sound generator. It *is* an instrument for modifying the remaining four characteristics independently of each other to give any desired wave shape or envelope. Quality is determined beforehand by filtering, reverberation, and often by the sheer nature of the sound chosen. A continuous sound of the desired quality is fed into a variable-gain amplifier, as shown in *Fig.* 1, consisting of a pair of variable-mu pentodes in push-pull, normally biased back beyond cutoff by an applied d.c. bias. As more and more of this bias is bypassed to ground, the gain of the amplifier rises by 2-db steps. If pins 9 and 10 on the left are shorted, the bias falls back past the cutoff point to the low-gain position. Shorting 8, 9, and 10 raises the gain by 2 db, and shorting 7, 8, 9, and 10 raises gain by another 2 db and so on. Since there is no direct control of the incoming signal itself, no distortion is introduced, and the actual switching arrangement can be widely separated from the amplifier since it carries only d.c. bias voltages. Any transients incurred in shorting the bias resistors are eliminated by adjusting the variable capacitor to give a time constant just long enough to avoid transient build-up and no more. This capacitor can be adjusted quite simply in a few seconds by trial and error. As there are six of these amplifiers, an output-level control has been added to each so that the user has some means of setting an over-all balance between the amplitudes of up to six sounds or signals fed through the Hamograph.

Actual switching of bias voltages is accomplished by a set of six motor-driven control tracks. The pins mentioned above are actually 10 spring-loaded feelers, see *Fig.* 2, all of equal length which bear down on a loop of 35-mm film leader stock. The arrangement is shown in *Fig.* 3. Stuck to the surface of the film stock with non-drying cement are control strips of aluminum foil and, as shown in *Fig.* 4, 5, and 6. It is the size, shape and spacing of

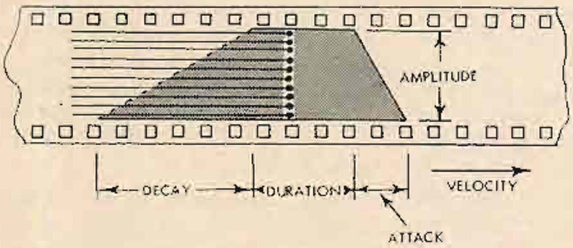


Fig. 4. The shape of the foil strip determines four of the five characteristics of a signal fed into the corresponding amplifier.

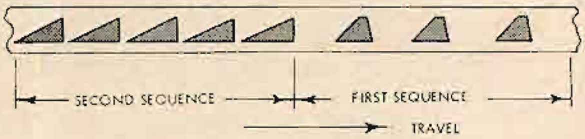


Fig. 5. Spacing of the foil strips controls the rhythmic pattern imposed on the appropriate signal.

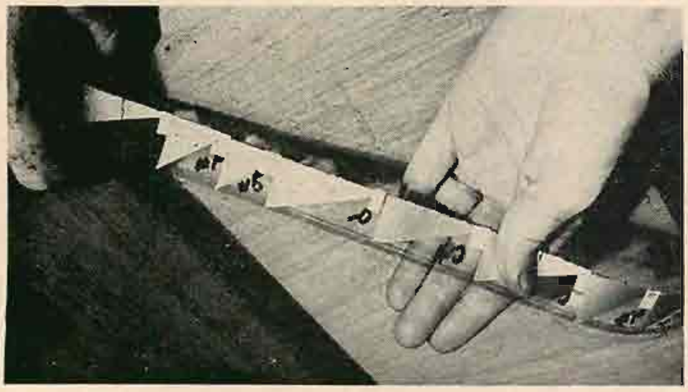


Fig. 6. A sample control track made up to demonstrate the varying amounts of decay obtainable with the Hamograph. Varying the slope of the front (right) edge will vary the attack, and so on.

(*Continued on page 27*)

BY 1965

YOU MAY SEE OTHER STEREO TUNER/AMPLIFIERS LIKE THE NEW ALTEC "ASTRO"

NEW CIRCUITRY, NEW FEATURES, NEW IDEA IN STEREO

"Modern" is not the word. Perhaps "ahead-of-its-time" is a bit more descriptive of the new Altec 708A "Astro." How else would you describe an all-in-one stereo center full of features and facilities never before available in a single package?

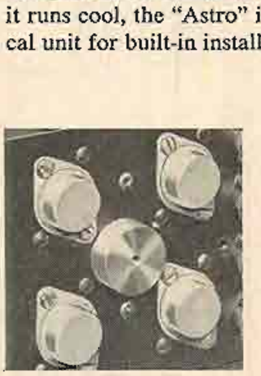
For example, consider its circuitry. Transistors are combined with new frame grid tubes to gain the best qualities of each. As another example, consider its unique stereo headphone facilities. The output receptacle is in the rear; you may leave the headphones plugged in permanently, out of sight when not in use. The headphone switch, however, is located conveniently on the front panel.

Or, consider the unique tape recording monitor that functions much like monitors in professional recording studios. Namely, it permits you to monitor any source material two ways *during* recording: the instant signal enters the record head or directly from tape, the moment it is recorded. And these features are only a sampling. Truly, the "Astro" is "ahead-of-its-time" even down to the smallest details such as the exclusive friction-lock controls that obsolete awkward dual knobs found on conventional stereo equipment.

COOLNESS OF TRANSISTORS—PRECISION OF FRAME GRID TUBES

For cool operation, Altec makes judicious use of transistors. For highest sensitivity and quietest performance imaginable, new ultra-precise frame grid tubes are used. This proper combination of transistors and tubes in the "Astro" has produced results that are just this side of miraculous.

The "Astro" is sensitive, stable and completely consistent in its performance (top-notch!) and utterly free of drift. Indeed, it is the first truly practical stereo center because transistors in the power stage make it run cool for hours on end. Unlike ordinary "hot boxes," the "Astro" secures peak operating efficiency and maximum life from resistors, capacitors, and other sub-components in its circuitry. And, because it runs cool, the "Astro" is the first practical unit for built-in installations.



55 watts from an area the size of a postcard!

That's the magic of transistors: the four shown at left make up the power stage of the "Astro." In all, 12 transistors and 17 tubes are used in this entirely new stereo center that is rated several years ahead of its time.

WHAT MAJOR COMPONENTS ARE INCLUDED IN THE NEW "ASTRO"?

Five integrated stereo components are packaged in a compact 6" x 15" x 13½" cabinet: FM, FM multiplex, AM, dual-channel preamplifiers, dual-channel power amplifiers. The wide band FM tuner features 1.2 microvolt sensitivity (equivalent to 0.75 microvolts with matched 72 ohm antenna) to assure highest gain, lowest noise. A built-in FM stereo multiplex receiver provides 30 db stereo separation between channels over the entire audio range. To take all guesswork out of tuning, a monitor light goes on automatically when stereo signal is received. The AM tuner provides high sensitivity and excellent image and IF rejection.

The preamplifier section features a complete complement of controls and includes facilities for everything from record and tape player to the stereo headphones. Powerful dual-channel amplifiers deliver 27.5 watts each down to 20 cycles (IHFM standard) with ± 1 db, 20-20,000 cps frequency response.

YOU MUST SEE & HEAR THE "ASTRO"

Feel it, too, for that all-important coolness. At your Altec Distributor's now. Or, for information, write Dept. A-10A

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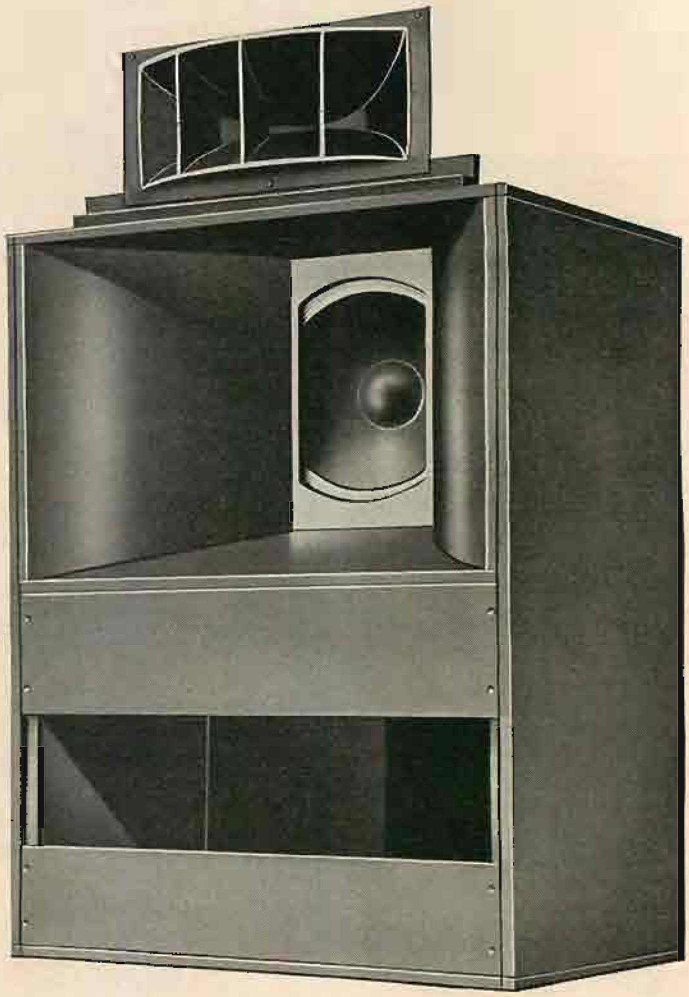

THIS IS NO COMPACT!

54 inches high
9 feet around the middle

That's a lot of speaker system. Enough for what pleases you. It can whisper or it can bellow. It does both superbly, and anything in between. So much so that Hollywood's famous United Recording Corp. (sound studio for record, tape, film, and tv industries) employs 15 of them. As does Ray Heindorf, musical director of Warner Bros.' production "The Music Man" and holder of 2 Oscars, who has four right in his living room.

No, this is definitely not a compact. It's a giant, this A-7 "Voice of the Theatre" by Altec. A full-size speaker system with quality to match. That's why it belongs in your home. Unless you are willing to settle for a compact "book shelf" speaker... and compact sound. Of course if you are a critical listener, you'll want your sound brought to life by Altec; sound so realistically reproduced, you'll find its equal only in the concert hall.

That much the A-7 will give you, and more. Almost in direct proportion to your own desire for perfection. If you insist on hearing the "full sound," the most subtle contribution of each instrument, the effortless reproduction of massive orchestrations at concert-hall listening levels, then the A-7 is for you.

Now here is a hint: you can't make it any smaller, but you can make it a lot prettier. All it takes is a bit of effort, some grille cloth, some veneer or paint and you can transform the A-7 into a custom furniture piece. For built-in installation, there's nothing so perfect. At only $285.00 each, it's a wonderful do-it-yourself project... for the critical listener.

However, if you prefer your A-7 sound coming from a more civilized version, we have several solutions, in walnut or mahogany. There's the 831A "Capistrano," a full-size beauty that offers speaker components identical to the A-7 in a classically styled cabinet. It stands 30″ high, 47″ wide, and is priced at $399.00.

The modern 838A "Carmel" is also a full-size, floor-standing system. It features two 12″ low frequency speakers (instead of the one 15-incher in the A-7) and the same high frequency section. It's priced at $324.00 with decorator base (shown) extra; standard model comes with round legs. The "Carmel" is also available with one low frequency speaker in a model called the 837A "Avalon," priced at $261.00.

ALTEC 838A "CARMEL"

ALTEC 831A "CAPISTRANO"

NEW! ALTEC 841A "CORONADO" SPEAKER SYSTEM

Apartment-size version of the full-size Altec speaker systems, the "Coronado" is styled to match a pair of "Carmels" when used as the center speaker in an Altec 3-channel stereo system. Recommended for small apartments where space will not tolerate larger speakers. The "Coronado" is 30″ H, 18″ W, 14″ D and is priced at $199.50.

Go ahead, convince yourself! The A-7 (and its prettier mates) are ready to tantalize you now, at your Altec Distributor's. Or, for latest stereo catalog, write Dept. A-10.

ALTEC
LANSING CORPORATION

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1515 South Manchester Ave., Anaheim, Calif.

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HAMOGRAPH

(*from page 24*)

these foil strips that determine the remaining characteristics of the sound fed through the control amplifiers. The way in which the feelers are shorted out by the foil dictates the rate at which the amplifier gain is raised, how far it is raised and the rate at which it is lowered again. The number and spacing of strips on the loop determine the rhythmic pattern on that particular loop, and the length of the loop determines the repetition rate of that pattern. Any of these factors can be varied individually to suit the composer, which thus gives him an almost infinite number of possible combinations of the basic characteristics of a sound.

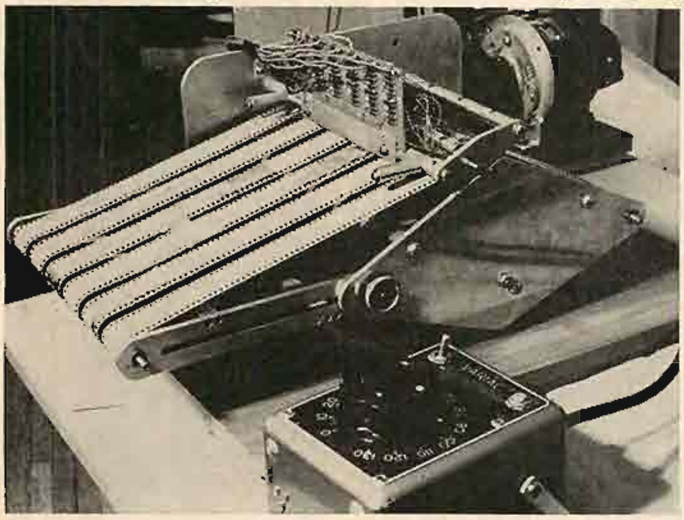

Fig. 7. The complete six-channel Hamograph. The variable-speed motor at the rear is controlled by the Variac in the foreground to change speed on all six tracks at once. Note resistors which attenuate bias are mounted on the feeler carriage. Wire placement is not critical since only d.c. voltages are involved.

A further facility is available in that the loops are driven from a single shaft, driven in turn by a variable-speed motor. Sprocketed film was chosen because of the ease with which a number of loops can be kept in absolute synchronism regardless of the speed at which they're run. Thus the actual velocity of the loops themselves can be varied, allowing the tempo of the patterns to be changed quite widely without altering their amplitude, tonal quality, pitch, or rhythmic relationship in any way. Attack, duration and decay will of course be changed as a result, but even this can be regarded as an asset if, for example, a composer is trying for a heightened emotional effect by increasing the tempo of a piece.

One of the biggest advantages of the Hamograph, apart from its obvious versatility, is the speed with which a specific effect can be tried. Control loops can be made up quite easily and almost any signal can be fed into the amplifiers via a simple patch rack. The outputs can be fed individually into a multitrack recorder owned by the Toronto studio, or mixed in any combination and fed stereophonically or monophonically into recorders or normal reproducing equipment. Reverberation units can be hooked into any or all of the channels as desired. The control strips can also be peeled off just as easily, if a particular control track is not wanted, and the film stock re-used. Also, because these loops are used for switching purposes, they can be made to apply the same characteristics to many different sounds. Unlike other media, the loops can be used many times over without imposing any degradation of quality on the sound itself. Conductive silver paint was tried at one stage but was rejected because of its permanence, and in fact with the foil strips the only limitation is the wear imposed by the friction of the feelers on the edges of the foil.

Needless to say, anything can be improved upon and plans are underway for a 24-channel version of the Hamograph to be built within the coming year. As Dr. Myron Schaeffer, one of the co-inventors, has pointed out, since the Hamograph is basically a programming device it has other uses beyond the realm of electronic music. It could even be used to program a sequence of lights in a shopping plaza, though it's doubtful whether such a use would have as long-lasting results as those in its present sphere of activity.

My grateful thanks are extended to Dr. Schaeffer and Prof. Harvey Olnick of the Faculty of Music, University of Toronto for their wholehearted assistance and encouragement in the preparation of this article.

References

"Hamograph, A New Amplitude Rhythm Control Device for Electronic Music": Schaeffer: pp. 22–24, *IRE Transactions, PGA* Jan–Feb. '62, Vol. AU–10 #1. Æ

Mr. R. A. Horn, a resident of Doylestown, Pa., writes, "Upon reading your advertisement in May, I just couldn't contain myself and had to write to compliment your truthful advertisement in an age when others would have you believe that good music comes from little speakers in little boxes...". Thank you, Mr. Horn. For the benefit of readers who may have missed the Sound Talk column that you refer to, we are repeating it below:

ALTEC SOUND TALK

HOW TO DECIDE IF A FULL-SIZE SPEAKER SYSTEM IS FOR YOU

First, you must decide whether you are a *critical* listener. If you insist upon hearing the "full sound", the most subtle contribution of each instrument—then you are relentlessly bound to the full-size system by your own need for perfection. On the other hand, if you're willing to compromise for a lot less than the total effect, you can learn to live for awhile with the musical midgets of "bookshelf row". Compact speakers *do* serve a definite need, provided one lives in a closet.

WHERE THE DIFFERENCE BECOMES MOST APPARENT

Complex orchestral passages involving great masses of sound quickly demonstrate the obvious advantages of full-size systems. Here's where you will truly appreciate the effortless reproduction of large speakers that are free of the strain exhibited by small speakers undergoing excessive excursions.

The difference between the two may not seem great if you are listening to a string quartet where the range of pitch and dynamics is closely limited. But compare them via a full-scale composition that really shivers the timbers, such as the currently popular orchestrations of Marty Gold or the "1812 Overture", and the effortless majesty of the big unit relegates the spunky little pretender to the bookshelf where it belongs.

THE REASONS WHY...

Full-size speaker enclosures are needed to house the big "woofers" plus the multicell or sectoral horns and drivers employed in professional, two-way systems. Leading audio engineers agree that there is no known way to reduce cubic displacement of a cabinet without reducing sound quality. Only a full-size enclosure provides air volume equal to the larger bass instruments—the double bass viol, kettledrum, etc. For the first time, outside the concert hall, you hear the lowest tones in their pure, undistorted state. The large power-handling capacity and higher efficiency of these full-size, no-compromise systems permit reproduction of every dynamic peak without driving the amplifier into distortion and clipping. In short, advantages of the full-size system combine to reward the perfectionist with a lifetime of listening pleasure.

THE "PROBLEM" OF SPACE

If you are a critical listener, the alibi "I don't have room for full-size speaker systems" is meaningless. You'll *make* the room in order to enjoy sound without compromise.

Altec Lansing Corporation

The Tape Guide

HERMAN BURSTEIN[*]

> *(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)*

Although the Tape Guide has repeatedly stated that it cannot make recommendations with respect to specific brands of equipment, I still get letters asking for such recommendations. Following is a request of this sort. However, in the present instance we have a very unusual letter, because it reveals a systematic and well thought out approach to selecting a tape machine. In this respect the letter is a model of its kind, and that is why I let it appear here, even though it cannot be answered as the writer desires. Actually the letter virtually provides its own answer. Anyone who approaches the selection of a tape machine with this much care will probably wind up with one that suits his needs.

Specifications and Tape Recorders

*Q. One year ago the * * * Audio Club was organized as a recreational facility of the * * * Company. Our present membership is twenty, all interested in audio as a hobby. Test equipment has been purchased in the past year which includes a tube tester, VTVM, audio generator, intermodulation, tester, FM alignment generator, oscilloscopic, and a * * * * tape deck. A work bench was built and a club room furnished during this period of time.*

*We purchased the * * * * deck so that the membership can become familiar with the use of tape with our home systems. Our 1962 budget has been approved for $550 for the purchase of a quality tape machine. With the club's machine available for making tapes, many of us will buy playback decks for our home systems. We believe you can help us decide which of the available machines will serve best in our club application. After much study and discussion we have narrowed the selection to the following, listed approximately in the order of preference.* (Here the writer listed five well-known tape recorders.)

We believe that these tape recorders will meet their advertised specifications closely enough to suit our needs. Our greatest concern is about factors not defined by specifications. Ruggedness of both mechanics and electronics, as well as reasonable simplicity of operation, are most important as our recorder will be moved frequently and operated by various people. Also, as there is a lack of known reliable local service, we will depend on factory service if unable to service the machine ourselves. (We have electronic, electrical, and mechanical engineers as well as machinists and instrument repair men in our group.)

The following features are considered necessary:

1. *Separate record and playback heads*
2. *VU meters (eliminates the * * * * machine)*
3. *Separate record and playback preamplifiers*
4. *Two speeds, 3.75 and 7.5 ips*
5. *Footage counter*
6. *Reasonable portability*
7. *Two- and four-track playback*

The following features are desirable:

1. *Dual VU meters*
2. *Automatic cutoff for tape breakage*
3. *Ability to handle ½-mil tape safely*
4. *Two- and four-track record*

The following features are not *needed:*

1. *Amplifiers and speakers*
2. *Extreme portability*
3. *Style or beauty*

A. I must express my adminration for the orderly way in which you have approached the problem of selecting a home tape machine. The scientific method is much in evidence. However, as you must recognize my hands are tied when it comes to be recommending specific tape machines.

You mentioned that one machine has been eliminated from consideration because it employs a magic eye instead of a VU meter as a record level indicator. You may want to reconsider your thinking about this factor. It takes a fair amount of skill to estimate peak level—where you run into substantial distortion—when using a VU meter, because the pointer lags, often considerably, on sharp transients. But the magic eye, being an electronic rather than mechanical device, responds instantly to transients, so that you know for a fact whether you are recording at, above, or below maximum permissible recording level.

Signal-to-Noise Measurement

*Q. I own a * * * * tape recorder and recently checked its performance against its specifications with the help of a friend who has the necessary instruments. Although the machine claims a signal-to-noise ratio of 55 db, we measured only about 50 db. We recorded a frequency of 400 cps at a level that sent the record level meter to 0 VU, played back this tone, and measured it. Then we rewound the tape, put it through the recording process again, but without an input signal played back the tape, and measured the output. The second output was 50 db below the first output. The tape machine seems to produce very little audible noise, but I am disturbed by the fact that it measures appreciably poorer than its specifications, especially when I take into account that this is quite an expensive tape recorder. I would appreciate your suggestions.*

A. I am quite sure that everything really is all right, especially since the most important measuring instrument of all, your ear, finds that there is very little audible noise. Your particular brand of tape recorder is calibrated so that a reading of 0 VU corresponds to a recording level at 400 cps that produces only 1 per cent harmonic distortions. But for home purposes, it is generally accepted that a maximum of 3 per cent distortion at 400 cps is acceptable. Going from 1 per cent to 3 per cent distortion corresponds to an increase of about 6 db in recording level. In other words, you could have put 6 db more signal on the tape before reaching 3 per cent harmonic distortion. Actaully, therefore, your machine has a signal-to-noise ratio of about 56 db, which is nothing to complain about.

The reason that your tape recorder shows 0 VU when the distortion is only 1 per cent is to allow for the mechanical lag of the pointer on sharp transients. Thus when a brief, strong peak comes along, the meter might show only 0 VU when the signal level is actually a good deal higher. We can say that the meter calibration incorporates a 6-db safety margin to prevent you from over-recording.

Any time you wish to check the signal-to-noise ratio of a tape recorder, you must be sure that you are checking this with reference to a standard recording level, not merely with reference to the indication of the recording level indicator, whether this be a magic eye or a meter. For home purposes, the standard recording level, as I mentioned before, is commonly accepted as that which produces 3 per cent harmonic distortion at 400 cps. For professional purposes, 2 per cent, or possibly 1 per cent, is apt to be used. Thus part of your testing equipment must be a harmonic distortion meter so that you can identify the standard recording level, regardless what the recording level indicator shows.

Sometimes attempts are made to measure signal-to-noise ratio with respect to "average" recording level rather than maximum recording level. However, it is quite difficult to say what average level really is. For some types of music or speech, the average level may be about 6 db below the peak level, whereas for other types the average level may be 10 db, 15 lb, or even 20 db below the peaks. Some persons have chosen "10 db below maximum recording level" as their definition of average level, but as you can see, the reference level really still remains that which results in 3 per cent harmonic distortion at 400 cps.

NAB Equalization

Q. What is NAB tape equalization, taking into account recording as well as playback?

A. NAB equalization specifies the following with respect to operation at 15 ips, although this is commonly accepted with respect to 7.5 ips as well. Assuming an "ideal" playback head—one whose output increases in direct proportion to an increase in frequency throughout the audio range—playback equalization shall consist of a bass-boost curve that commences at 3180 cps (up 3 db at this frequency), continues to rise as frequency goes down, but eventually levels off, so that at 50 cps the response is 3 db below the maximum that it eventually attains. Altogether, bass boost amounts to 36 db. To the extent that the playback head departs from the ideal, the playback equalization is required by the NAB standard to compensate for this departure. Thus if the head displays high-frequency losses (due to gap width and other factors), playback treble boost has

(Continued on page 56)

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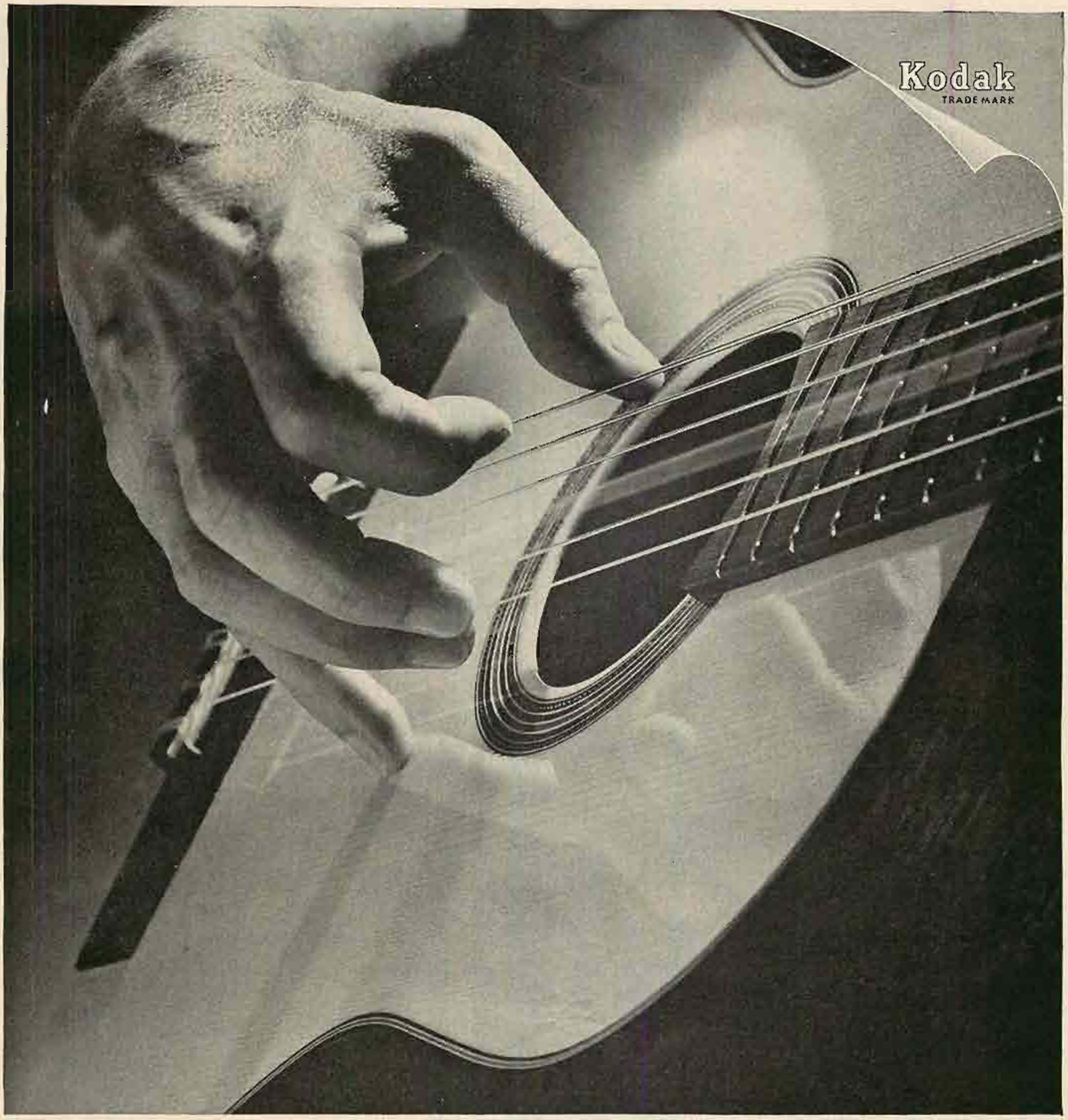
[*] *280 Twin Lane E., Wantagh, N. Y.*



YOU SUPPLY THE FREQUENCIES . . . KODAK TAPE SUPPLIES THE RESPONSE

And what response! KODAK Sound Recording Tape is designed to give you unexcelled tone reproduction over the entire audio range from 40 to 20,000 cycles. This response provides vibrant sound reproduction lost in some other tapes. KODAK Tape has a coating uniformity that never varies more than plus or minus .000014 inch. Without such uniformity you can expect a loss in high frequencies that can only be compensated for by setting bias incorrectly. Result? Distortion! KODAK Sound Recording Tape is lubricated on both sides to minimize head and tape wear. That's not all. KODAK Tape has maximum freedom from drop-out plus a smooth flexibility that insures intimate contact with the heads. The tape reel practically threads itself and has a built-in splicer. Make your next reel KODAK Sound Recording Tape. It's as good as your favorite color film!

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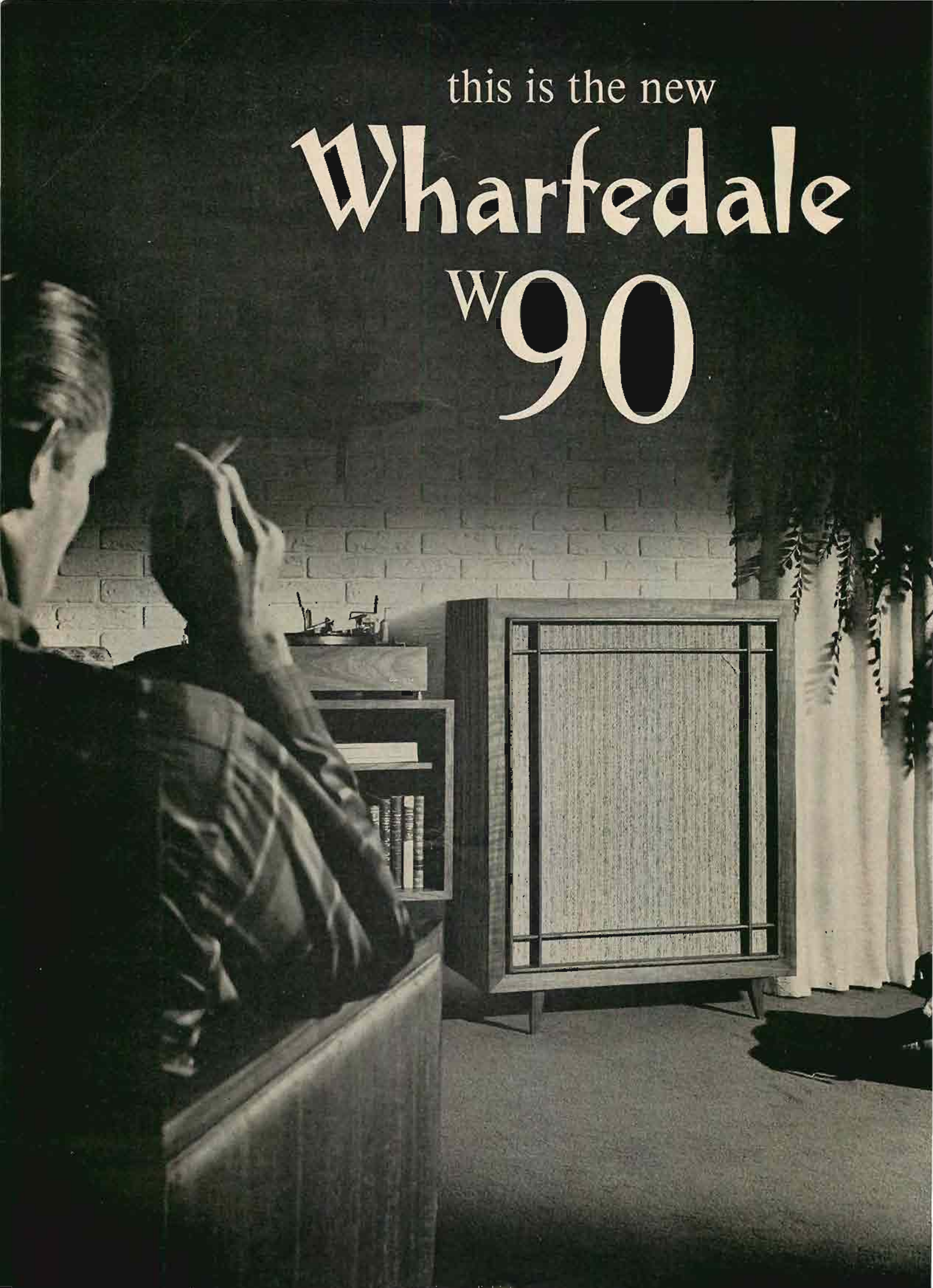
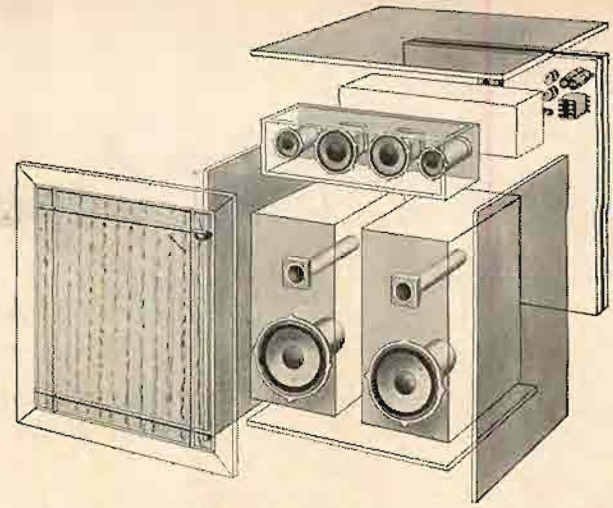

this is the new
Wharfedale
W90

..a dual 3-way speaker system

6 speakers—2 bass, 2 mid-range, 2 treble...superbly matched and integrated with a magnificent sand-filled enclosure



THE W90 is destined to restore the legendary sound of former years...the sound of the great Wharfedale systems used by G. A. Briggs in his concert demonstrations at Carnegie Hall, Royal Festival Hall and others throughout the Western world. The Wharfedale systems he used to recreate the full symphony orchestra, single instruments from triangle to organ, and the voice...all at correct volume, and without coloration or distortion...were compared by the thousands in his audiences to simultaneous live performances on the same stages. Imperfect as such experiments had to be, the natural, realistic quality achieved by these homely but wonderful Wharfedale speaker systems accounts for the unassailable loyalty of those who heard Mr. Brigg's concert demonstrations or heard about them. And as musically-oriented people have grown more sophisticated in listening to stereo, there has been an increasing demand for the restoration of the full authority of these large, earlier Wharfedales. Unfortunately, this kind of sound, up to the present, has been the exclusive province of systems too cumbersome for most living rooms, especially when used in pairs for stereo. Now, benefiting from the advancements developed for its compact Achromatic series, Wharfedale has successfully designed a new size and format. It is a special sand-filled system, proportioned specifically to accommodate the components required today to accomplish this ambitious purpose. Measurements are 32¼"x27¾"x13⅛".

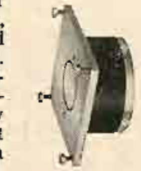
The new W90, therefore, is neither a compact, nor is it a large speaker system. It is a new and highly versatile size, designed from the sound out ...with absolute insistence upon the results desired, yet with an eye to the latest decorative trends in stereo arrangement.

All six speakers incorporate certain recent refinements which have made possible the task of creating the W90 system. A brief description will clarify what we mean:

The chassis (baskets) are exceptionally heavy and manufactured by casting. The purpose is to preserve absolute rigidity, maintaining the critical relationship between the moving voice coil and the fixed magnet. The stamped baskets found in ordinary loudspeakers are also designed to be rigid. However, this rigidity is often lost as soon as the speaker is mounted firmly against an inexact wooden front baffle. Some speaker designers have even eliminated the basket, weakening the entire speaker structure. Wharfedale baskets are of cast metal. They hold their shape perfectly in mounting, and are strong enough to permit sufficient openings to maintain absolutely correct airloading, essential for the full response of the speaker.

The Cone Surround is an exclusive rolled-rim design, the latest and most effective form of the traditional Wharfedale soft suspension. Earlier surrounds (porous foam or cloth) provided such superior bass damping that they became renowned as an outstanding physical characteristic of Wharfedale speakers. Now, more than ever before, the Wharfedale cone is capable of the long excursions required for true bass energy in a sophisticated tuned duct enclosure. The cone material is special...compounded of long fibred wood (traditional to the North of England home of these speakers) and *soft* pulp! It achieves superior results from the start and its natural resilience assures continuing perfection over the years.

The Magnets are truly impressive, individually and totally. Because of its material, and the special design of the magnetic gap, each provides higher total flux in the gap field than has been true of the magnets in any prior speaker system. The six magnets together make the W90 a "high efficiency" speaker, achieving maximum performance at low amplifier power. All-too-many popular speaker systems are starved for power, depending upon exaggerated amounts of amplifier wattage. In the W90, therefore, the all-important transient bass response is excellent, even at low volume. This clean low end, at reasonable listening levels, is a major reason why all Wharfedales are so pleasant to "live with."



With its six speakers, the W90 is actually a dual 3-way system with all units designed for each other and crossover settings calibrated for undistorted response throughout the audio spectrum. The support effect of the tandem speaker systems results in a sound of exceptional authority, yet in balance over the entire range.

LOW RANGE. Two 12½" low frequency drivers handle the sound from 20 to 1,500 cycles. The listener can expect to enjoy the true, fundamental bass notes, so often masked. The two drivers total a cone area of 94 square inches...thus the W90 tandem idea yields the same result as a single low frequency driver of such massive size and weight as to be impractical in the home.

MID-RANGE. Two 5¼" mid-range speakers cover the relatively narrow but vital band of 1,500 to 6,000 cycles. The listener will be startled, for example, by the clarity of the baritone voice and the exceptional resolution of most solo instruments, permitted to stand in correct perspective. The handling of this "fill" range in the W90 is the recognizable key to its satisfying full-throated sound.

TREBLE. Two 3" treble speakers are the well-established Super 3's, much admired for their ability to present the clear treble without stridency...making them eminently listenable, unusual for tweeters. This is no accident. It is the result of cone-type rather than horn-type construction, and refinements such as low-mass aluminum voice coils ultrasonically tinned, powered by magnets so large that they are seldom found even in speakers four times the diameter!

THE W90 is the latest of the Achromatic speaker systems. The literal meaning of "achromatic" is: "Pure sound, uncolored by extraneous modulations." Such modulations, common even in luxury speaker systems, tend to alter the natural sound of music. The W90 enclosure has been designed to preserve the integrity of the speakers' performance, through certain constructional features. Chief characteristic of the Achromatic construction is the sand-filled technique, which consists of packing white sand densely between layers of hardwood. This creates an inert mass, incapable of resonating no matter how deep or strong the bass backwave projected against it. This technique, exclusive to Wharfedale, is the result of years of development by G. A. Briggs. While it costs considerably more than standard construction, it has proven so effective in preventing bass distortion that all Wharfedale Achromatic systems incorporate it. Each woofer is mounted in an individual tuned chamber for its own maximum effect, and isolated from the mid-range and tweeter arrays. Therefore, mechanical coupling, so disastrous in ordinary systems, is eliminated. The high and mid-range speakers are mounted from the rear, isolated from the face of the cabinet with front free-floating. This important feature helps to eliminate phase distortion. As a final measure, to insure compatability with the acoustics of the room, the W90 system incorporates a full control panel. Each range of speakers may be balanced and adjusted to the ear of the listener, the requirements of the particular listening area and the other components in the music system.

DECOR. The Wharfedale W90 is housed in a meticulously crafted cabinet built to meet every requirement of perfection in sound...yet it will fit with ease into the living room, and is elegant enough to join the most distinctive furnishings. Its acoustic design adds versatility...permitting horizontal or vertical use as desired. The Wharfedale Universal Mounting Base makes it a superb free-standing unit. In oiled or polished Walnut hardwood, $259.50. Utility model in sanded birch hardwood, without curved molding or dividers, $244.50. Universal mounting base to match $9.95.

For illustrated literature write Dept. WR 12

Wharfedale • Division of British Industries Corp., Port Washington, N.Y.

Audio Engineering Society

FOURTEENTH ANNUAL CONVENTION

Following is a complete list of papers to be presented at the fifteen technical sessions.

Monday, October 15, 1962

9:30 a.m. MICROPHONES AND EARPHONES

Robert W. Carr, Shure Bros., Inc., Chairman

Precision Condenser Microphones, Their Purpose, Characteristics and Calibration
Jack Mowry, B & K Instrucents, Inc.

Design Considerations in an Industrial Microphone
A. L. Dvorsky, The Astatic Corporation

Intelligibility of Communication Ear Defenders in an Area of Extremely High Ambient Noise
Robert P. Devaney, Roanwell Corporation

Improved Noise-Cancelling Microphone
D. O. Rail and A. J. Brouns, Shure Bros., Inc.

The Trend in Sub-Miniature Magnetic Transducers
E. V. Carlson, Industrial Research Products

High-Quality Push-Pull Condenser Transmitters
G. M. Sessler and J. E. West, Bell Telephone Laboratories, Inc.

1:30 p.m. AUDIO ELECTRONICS

D. R. von Recklinghausen, H. H. Scott, Inc., Chairman

Design Aspects of Low-Distortion Transistor Amplifiers
Murray Barlowe, Harman-Kardon, Inc.

Some Problems in the Design of High-Power Transistor Amplifiers
Alex Robbins, Standard Systems Corporation

A High-Power Solid-State Amplifier
Thomas W. Pickett, H. W. Scott, Inc.

One-Kilowatt Transistor Audio Amplifier
Richard S. Burwen, Consulting Electronics Engineer

Simplified Frequency Shifter for Improving Acoustic Feedback Stability
Mahlon D. Burkhard, Industrial Research Products, Inc.

A Reflex Wien-Bridge Oscillator
Joel H. Levitt, Columbia-Princeton Electronic Music Center

A Transistorized Dynamic-Microphone Amplifier for Telephone Handset
Warren R. Yuenger, Ling-Altec Research

7:30 p.m. LOUDSPEAKERS

P. B. Williams, Jensen Manufacturing Company, Chairman

Multi-Speaker, Multi-Channel Arrays, Column Type
J. F. Novak, Jensen Manufacturing Company

Constant Directional Characteristics from a Line-Source Array
David L. Klepper, Bolt Beranek & Newman, Inc.

Measurement of Loudspeaker Response in Live Rooms
George W. Sioles, CBS Laboratories

A Simplified Quality-Rating System for Loudspeakers
Lincoln Walsh, Walsh Engineering Company

Comparisons of Transducers Operating on Different Basic Principles
William B. Snow, Bissett-Berman Corp.

Electrostatic Transducers for Ultrasonics
John J. Van Houten, Ling-Temco-Vought, Inc.

Low-Cost Anechoic Chamber for E.I.A. Loudspeaker Measurements
Peter Davidson, Eng. Div., Hammond Organ Company

Tuesday, October 16, 1962

9:30 a.m. DISC RECORDING AND REPRODUCTION I

Edward H. Uecke, Capitol Records, Inc., Chairman

Phonograph Stylus-Tip Finish—Effect on Record Signal and Noise
P. Adler and M. S. Shatavsky, Sonotone Corporation

A Study of Program-Level Overloading in Phonograph Recording
J. G. Woodward and E. C. Fox, RCA Laboratories

Program-Level Overloading and Equalization in Phonograph Recording
E. C. Fox and J. G. Woodward, RCA Laboratories.

New and Superior Driving Amplifiers for the Westrex 3C, 2B, and Grampian Feedback Cutters
Howard S. Holzer, Contemporary Records and HAECO

A Two-Gram Phonograph Pickup System for Home Record Changers
B. B. Bauer, A. L. Di Mattia, E. Kaulins, and G. W. Sioles, CBS Laboratories

Precision Testing of Phonograph Sound Reproduction Components and Systems
Jack Mowry, B & K Instruments, Inc.

A New Turntable-Arm Combination
Edgar Villchur, Acoustic Research, Inc.

1:30 p.m. DISC RECORDING AND REPRODUCTION II

Donald J. Plunkett, Fairchild Recording Equipment Corp., Chairman

Control of Static Electricity on Phonograph Records
G. P. Humfeld, RCA Victor Division

Pickup Design Problems in Tracking Below One Gram
W. O. Stanton, Pickering & Company

Transient Response and Intermodulation Studies in Phonograph Reproduction
B. B. Bauer, A. Schwartz, and A. Gust, CBS Laboratories

The Rational Design of Phonograph Pickups
F. V. Hunt, Harvard University

A Phonograph Cartridge Evaluation Recording
Allan R. Keskinen, The Astatic Corporation

On the Damping of Phonograph Arms
B. B. Bauer, CBS Laboratories

High-Frequency Stylus-Groove Relationships in Phonograph Cartridge Transducers
Philip Kantrowitz, Sonotone Corporation

7:30 p.m. (McMillin Theatre, Columbia University) MUSIC AND ELECTRONICS

Harald Bode, The Wurlitzer Company, Chairman

Electronic Simulation of the Organ
Norman C. Pickering, Astrosonics, Inc.

Some Psychoacoustical Results in Musical Research
Melville Clark, Jr., Sylvania Electric Products, Inc.

The New Wurlitzer Electronic Piano
Clifford W. Anderson, Harold Bode, and Harold O. Schwartz, The Wurlitzer Company

Musical Preception and Electronic Composition
Milton Babbitt, Princeton University

Creation of Melodic Contours from Non-Melodic Raw Material Without Loss of Text or Timbre
Myron Schaeffer, University of Toronto

Multi-Channel Performance of Electronic Music
Valdimir A. Ussachevsky, Columbia-Princeton Electronic Music Center

7:30 p.m. RECORDING TECHNIQUES IN EUROPE

Gilbert F. Dutton, Electric & Musical Industries, Chairman

Considerations in the Measurement of Rumble
P. Burkowitz, Carl Lindstrom, G.M.B.H.

An Automatic Overplay System for Magnetic Tape and Record
H. Redlich and J. J. Klemp, Telefunken-Decca

Correlation Meter for Checking the Poling of Stereo Signals
W. S. Percival, Electric & Musical Industries, Ltd.

Recorded Acceleration and Tip-Mass Distortion
J. Walton, Decca Record Co., Ltd.

Further Thoughts on Geometric Conditions in the Cutting and Playing of Stereo Discs
C. R. Bastiaans, Philips Phonographic Industries

The Ortofon Stereo Cutterhead, Type GSS 601
E. Knudson, Ortofon Industry A/S

Wednesday, October 17, 1962

9:30 a.m. MAGNETIC RECORDING

Rein Narma, Ampex Corporation, Audio Division, Chairman

Erasure of Magnetic Tape
John G. McKnight, Ampex Corporation, Audio Division

Noise Considerations in Tape Reproduce Amplifiers
Erling P. Skov, Ampex Corporation, Audio Division

Correlation Studies Relating Magnetic Measurements to Audio-Frequency Performance of Magnetic Tape
Donald H. Blouch and Walter L. Anderson, General Kinetics, Inc.

Intermodulation Distortion in Tape Recording
Robert Z. Langevin, Ampex Corporation, Audio Division

A New Transistorized Professional Tape Recorder
R. J. Tinkham, Vega Electronics Corporation

A Review of German DIN Standards on Magnetic Sound Recording and Related Subjects
John G. McKnight, Ampex Corporation, Audio Division

1:30 p.m. REQUISITES OF MODERN TELEPHONY

F. K. Harvey, Bell Telephone Laboratories, Inc., Chairman

Man's Need to Communicate—Past, Present, and Future
Charles W. Vadersen, ITT Communications Systems, Inc.

Joint Use of Telephone Lines for Voice and Data Transmission
F. K. Becker, Bell Telephone Laboratories, Inc.

The Role of Recorded Voice Services in Telephony
W. C. Tillistrand, New York Telephone Co.

Telephone Circuits for Program Transmission
Iden Kerney and A. D. Fowler, Bell Telephone Laboratories, Inc.

TASI, a Band-Compression System
F. A. Saal, Bell Telephone Laboratories, Inc.

Compatibility—a Major Requisite of the Telephone Industry
J. N. Petrie, Automatic Electric Co.

Military Use of Bell System Services
R. E. Gradle, Long Lines Dept., AT&T Co.

The Future of Digital Communication
E. Baum and W. S. Litchman, ITT Communications Systems, Inc.

7:30 p.m. STEREOPHONICS

B. B. Bauer, CBS Laboratories, Chairman

The Application of Stereophony to Conference Use
F. K. Harvey, J. G. Cisek, D. J. MacLean, and M. R. Schroeder, Bell Telephone Laboratories, Inc.

Educating the Layman about Stereo
N. Crowhurst, Gold Beach, Oregon

Space Information in Stereophony
M. Fouque and H. Redlich, Telefunken Decca

Some Techniques Toward Better Stereo Sound
B. B. Bauer, CBS Laboratories

Panel Discussion, "What Hath Stereo Wrought"
Panel of Experts to be announced at the session.

Thursday, October 18, 1962

9:30 a.m. SOUND REINFORCEMENT AND ACOUSTICS

J. E. Volkman, RCA Laboratories, Chairman

Integrated Sound System Design
Paul Steigman, Standard Systems Corporation

A Personal Voice Amplifier
D. J. MacLean, Bell Telephone Laboratories

Sound Amplification System for the New Fisher Theater, Detroit, Michigan
David L. Klepper, Bolt Beranek & Newman, Inc.

Sound Reinforcement in Television Studios
A. Pierce Evans, Columbia Broadcasting System

The Intercom Approach to a Voice-Assist System in a Large Church Auditorium
Robert S. K. Brown, The First Church of Christ Scientist, Boston, Mass.

New Techniques in the Measurement of Reverberation Time
T. J. Schultz, Bolt Beranek & Newman, Inc.

The New RCA Italiana Recording Studios in Rome, Italy
B. Bolle, H. Voldner, RCA Italiana; A. A. Pulley, A. Stevens, RCA Victor Record Division; and J. E. Volkmann, RCA Laboratories

The Sound System of Sound and Light
E. R. Hanson, North American Philips Co., Inc.

1:30 p.m. FM-STEREO BROADCASTING—I

Warren L. Braun, Chief Engineer WSVA AM-FM-TV, Chairman

A report of the CCIR Conference, Study Group X, June 1962, Bad Kreuznach, West Germany
William Beaubien, General Electric Co.

Stereophonic FM Distortion Caused by Crosstalk into the Pilot Carrier
Edward B. Bench, Jr., Chief Engineer, KCFM

Stereo Operational Experience of WQXR-FM-AM
L. K. Kleinklaus, Chief Engineer, WQXR and WQXR-FM, The Radio Station of the New York Times

Planning a New FM-Stereo Station
Lloyd Jones, Chief Engineer & Partner, KMUX-FM

Anomalies of Presently Accepted FM-Stereo Measurement Technique
Robert A. McClanathan, Chief Engineer, KPAM-KPFM

Techniques of Program-Level Measurements Applicable to FM Stereo
D. Ridgely Bolgiano, Director, Engineering Services Division, Drexel Hill Associates

Management's View of FM Stereo
A. J. Eicholzer, Chief Engineer, WSYR-FM

Friday, October 19, 1962

9:30 a.m. FM-STEREO BROADCASTING—II

Warren L. Braun, Chief Engineer WSVA AM-FM-TV, Chairman

Solutions to Problems Arising from Simultaneous Stereo and SCA Operation of an FM Station
Frank E. Laughlin, Chief Engineer, WGEM-TV-AM-FM

A Practical Guide to FM Station Layout and Tune-Up
Everett J. Gilbert, Collins Radio Company

Stereo Modification of Composite Equipment Including Type Acceptance Tests
James V. Melonas, WSFM

Stereo Experience at WASH-FM
Everett L. Dillard, General Manager, WASH-FM

Management FM-Stereo Installation Problems
C. N. Duncan, KGB-FM

FM Station Tests and Operation Without Type Approved Modulation Monitor
Ross Utter, Chief Engineer, Zenith Radio Corporation

1:30 p.m. BROADCAST AUDIO/STUDIO EQUIPMENT

A. H. Lind, RCA Broadcast & Communications Division, Chairman

Automatic Control of a Cartridge Magnetic Tape Recorder
C. B. Meyer, RCA Broadcast & Communications Division

BC-7A Stereo/Dual-Channel Audio Consolette with Transistor Circuitry
A. J. May, RCA Broadcast & Communications Division

Design Aspects of a High-Performance Solid-State FM-Stereo Tuner
George Meyerle, Harman-Kardon, Inc.

An Automatic Gain Shifter for Simultaneous Two-Way Voice Channels
S. H. Harrison, Bankers Trust Company, George Alexandrovich, Fairchild Recording Equipment Corp.

Meter Ballistics Testing
Henry C. Littlejohn, General Radio Company

Active Building-Block Studio Console Components and Their Use
Gerhart Bore, Georg Neumann Laboratorium fur Elektroakustik, G.m.b.h. Translated and presented by Stephen F. Temmer, Gotham Audio Corp.

7:30 p.m. PSYCHOACOUSTICS

J. D. Harris, USN Medical Research Laboratory, Chairman

Objective Behavioral Indicators of Hearing in the Animal
T. D. Clack, The C. W. Shilling Auditory Research Center, Inc.

New Research on Hearing
Willem A. Van Bergeijk, Bell Telephone Laboratories, Inc.

An Equipment Array for Studying Auditory Cues in the Blind
P. N. Herman and J. F. Curtis, The C. W. Shilling Auditory Research Center, Inc.

Speech Reception Under a Wide Variety of Distortions
R. L. Sargeant, USN Medical Research Laboratory

The Acoustic Contribution of the Head and Pinnae to Localization of Sounds in Space
J. D. Harris, USN Medical Research Laboratory

A New Turntable-Arm Design

EDGAR VILLCHUR*

Incidental to a description of a new product in the realm of record-playing equipment is this thorough analysis of the physical principles and the geometry involved in the design of an arm and turntable.

IN TWO PARTS—PART 2

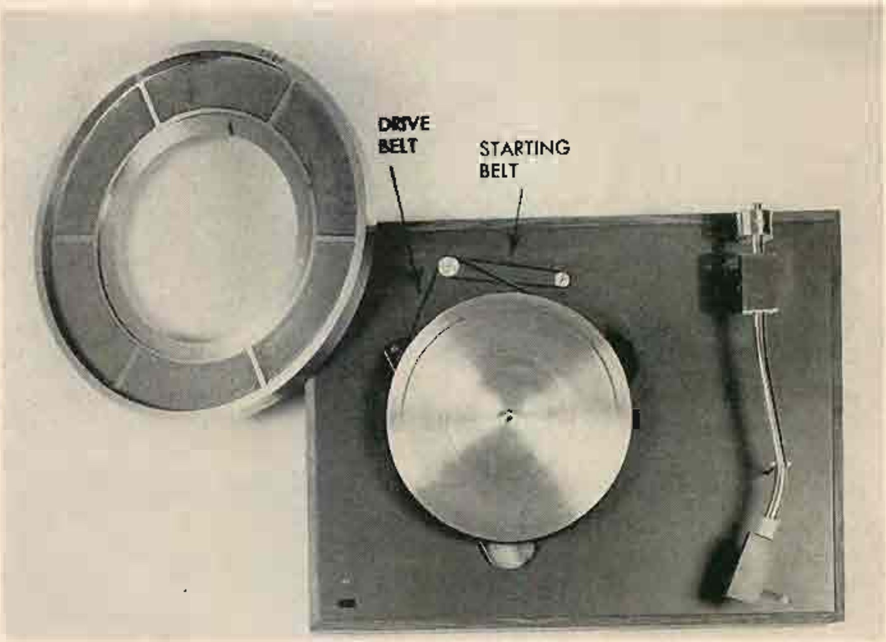


Fig. 7. Motor drive system of AR turntable.

Two types of motors are in general use for turntables. These are the induction motor (4-pole for the better units) and the hysteresis synchronous motor. The induction motor can be made with high starting and running torque—about three times higher than that of a hysteresis motor of similar size and rating. A disadvantage of the induction motor is that its rotor speed is less than that of the synchronous rotating field, a phenomenon referred to as rotor "slip." There must be a relative velocity between the rotor and the rotating magnetic field, or no current and no magnetic poles will be induced in the rotor.

The exact amount of the slip, which determines the motor speed, can vary with changes of line voltage, mechanical load, and temperature. Measures taken to counteract this speed drift, however, can result in stable induction motors.

The rotor of a hysteresis synchronous motor, unloaded mechanically, turns at the same speed as that of the rotating field. The rotor, being at rest with respect to the field, sees fixed poles which induce the rotor poles, and the motor works on these directly induced poles. Its speed in the unloaded condition is thus purely a function of the number of stator poles and of line frequency, unaffected by line voltage or motor temperature.

When the mechanical load of a hysteresis synchronous motor is increased sufficiently, however, the motor will slow down and work at sub-synchronous speeds on new sets of rotor poles, in spite of the relatively high retentivity of the rotor material. To overcome this difficulty hysteresis motors are typically made heavy, with the attendant increase in cost.

One type of hysteresis synchronous motor that has been used in recent years is the small motor normally intended for clocks and other time-regulation applications. The motors of this type that have appeared in turntables have some definite advantages, over and above low cost, over previous motor designs. The central feature from which these advantages stem is a low rotational speed. This makes it more convenient to use a single-step drive system, that is, a system which employs a single belt or friction wheel from the motor pulley to the turntable platen, with no idler wheels or other intermediary coupling devices. These motors turn at 600 rpm, and the speed reduction ratio for 33⅓ rpm is only 18 to 1. With the standard 1800-rpm 4-pole induction or hysteresis motors, the speed reduction ratio would be 54 to 1. A single-stage system carries with it the advantages of simplicity, reliability, reduced coupling slippage, and the use of a minimum number of moving parts.

The low speed of these motors also helps in providing reduced motor vibration. What small vibration there is includes a component that is subsonic in frequency and inaudible as rumble. As has already been pointed out, rumble at a given level that is very low in frequency has greatly reduced annoyance value.

The outstanding disadvantage of the time-regulation motors that have been used is their low torque, requiring light platens. In order to overcome this disadvantage partially, and to provide greater stability of turntable speed with changes of load (caused by differences of stylus force, and so on) two such motors are sometimes used.

The motors of this type currently used

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* *Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass.*

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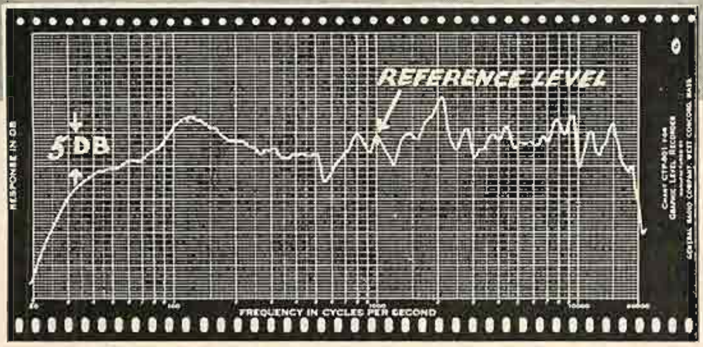

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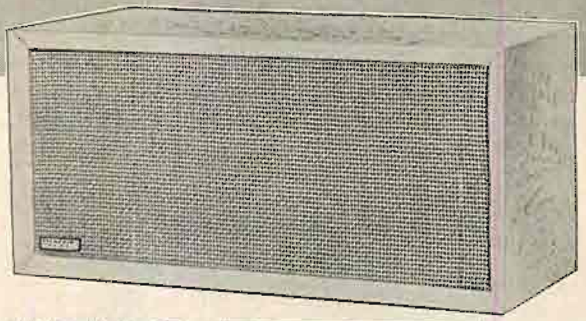

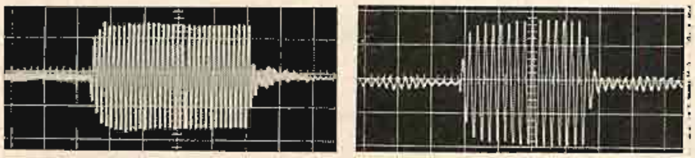

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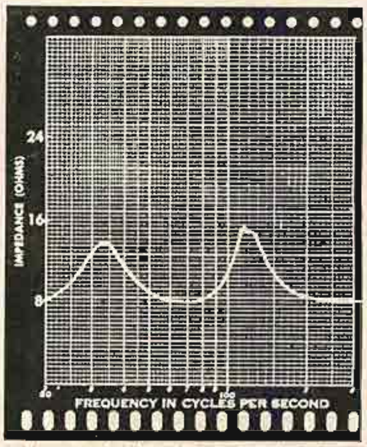
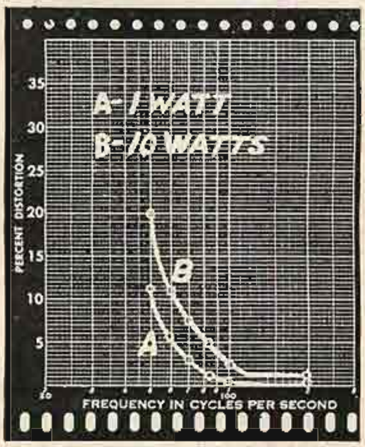
Bruel & Kjaer Microphone Amplifier Model 2604
General Radio Beat Frequency Oscillator Model 1304B
General Radio Graphic Level Recorder Model 1521
Hewlett-Packard Signal Generator Model 200CD
Hewlett-Packard Distortion Analyzer Model 330B
Ballantine Vacuum Tube Voltmeter Model 310A
Tektronix Oscilloscope Model 503
Delco Radio Div. Tone Burst Test Generator Model XP-13295

Data derived from ten production units.



Cabinart Mark 3 impedance characteristic.



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in commercial turntables are rated by the motor manufacturer as having 30 in.-oz. of running torque referred to 1 rpm, which means that the two-motor units have 60 in.-oz. In the case of the AR turntable a heavier platen is used —the total platen weight is 3.3 lbs.— and more torque was desired.

A third type of motor was investigated, and found highly satisfactory for turntable use from several points of view. This is the permanent magnet synchronous motor. The rotor of this synchronous motor, as the name implies, derives its magnetic field from permanent *magnets*. The recent development of ceramic magnets with high retentivity has helped considerably in PM motor design.

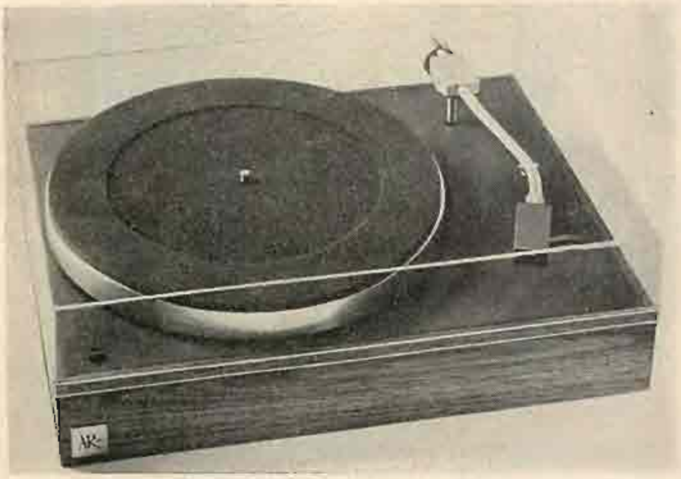

Fig. 8. The complete AR turntable.

The PM motor cannot work at any speed except synchronous speed, since its poles are permanently fixed, and it has high synchronous torque. The motor selected provides about 150 in.-oz. of running torque, even though its physical size is small. Unfortunately this motor has very poor starting torque, and it is not unidirectional, that is, it is as willing to go clockwise as counterclockwise, depending on the direction in which it is first urged. Mechanical "noback" devices, which allow rotation in only one direction, tend to be noisy.

The configuration that is used in the AR turntable for the motor system is shown in *Fig.* 7. The drive motor to the left is of the permanent magnet synchronous type, an 18-pole, 400-rpm unit. The starting motor on the right is the same hysteresis synchronous 600-rpm type currently used in other turntables.

Although the latter motor adds about 30 in.-oz. of running torque to the system, its real function is to start the PM motor, and in the right direction. The total torque of 180 in.-oz., which can be translated to a little over 5 in.-oz. at the platen itself, is still not tremendous and will not saw wood, but it is entirely adequate for its reproducing application.

One especially desirable characteristic of the permanent magnet synchronous motor is that it does not slow down gradually with increasing load before stalling, as does the hysteresis synchronous motor. Unlike the hysteresis rotor the permanent magnet rotor cannot shift poles. It maintains its correct and exact speed within its torque capabilities—it cannot run off-speed unless the line frequency is changed—and then stalls out abruptly.

The PM synchronous motor is inferior to the hysteresis synchronous motor in the smoothness of velocity within one revolution. The filtering requirements of a permanent-magnet-motor drive system, compared to those for a hysteresis-motor drive system, are therefore greater.

Useful Turntable Torque

It is possible for a turntable to be driven by a large amount of power, yet be unable to maintain stable speed in the face of only a slight increase in mechanical load. The test of *useful* turntable torque is the force required to slow the platen beyond the NAB limit on speed inaccuracy, not the force required to stop the platen.

The willingness of a turntable to run a little slow with only a slight increase in mechanical load often bears little relationship to the size or power of the motor. This speed inconstancy may be a function of the type rather than the size of the motor, or it may be due to coupling slippage between the motor and platen.

Useful turntable torque cannot be tested by trying to stop the platen by hand. A turntable which can be stopped easily with a finger may keep its speed within the NAB 0.3-per-cent limit in the face of a greater load change than that tolerated by a turntable which requires much greater effort to stop by hand.

One method of determining useful torque is to see how much additional weight can be added to the pickup, while it is playing the outside grooves of a record, before the speed is changed 0.3 per cent. Such a speed change represents a drift of 21 lines/min. on a standard stroboscope card. The lines must be counted while holding a pencil or some other point near them, as it is easy to be misled by merely glancing at the card.

Placing a U. S. penny on the pickup shell adds 3 grams; a nickel adds 5 grams. The significance of this added test load is indicated by the fact that the difference in drag imposed by a pickup when playing the outside grooves of a record, and the drag when the pickup is on the inside grooves, is typically equivalent to about 2 added grams of stylus force. The drag of a "Dust Bug" is equivalent to about 6 extra grams. A heavily recorded passage may slow the turntable to the equivalent of a gram or two extra stylus force. The above data will vary somewhat with the friction of different records and needles, but it gives the general order of equivalent values.

The carrying of a few extra grams by the pickup may seem too light a trial for a turntable, but there are units that will not pass the nickel and/or penny test. The degree of sensitivity to increase of mechanical load of a group of five current commercial turntables, including the AR turntable, was measured and compared by this method. The turntables were not a random sampling of available makes, but were selected to illustrate particular types. Three of the turntables—#1, #2, and the AR turntable—kept well within the NAB 0.3 per cent speed limit when the pickup was loaded by an extra 5 grams from an initial 2½-gram needle force. Turntable #1 had a heavy-duty hysteresis motor and a very heavy platen. Turntable #2 was of the "light" type, in both motor torque and platen weight. Compared to these two the AR turntable would be classified as medium-weight.

The other two turntables—#4 and #5—were slowed down more than 0.3 per cent when the pickup was loaded by a 3-gram penny, and were slowed down considerably more when the pickup was loaded by an extra 5 grams. #4 had a heavy motor and platen, and #5 would be classed as a lightweight.

It is of special interest that it takes some effort to stop turntable #4 by hand, while the AR turntable and turntable #2 can be stopped with relatively light pressure from a finger. Turntable #4 nonetheless has less useful torque than either of the latter. #4 will con-

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tinue to revolve, at an unusably slow speed, under mechanical loads which would cause the AR turntable or turntable #2 to stall out.

It should be clear that the index of useful turntable torque is neither the "heavy" or "light" classification of the turntable, nor the force required to stop the platen by hand.

Speed Accuracy

The AR turntable will slow down several tenths of a per cent if sufficient increase of mechanical load is applied to the pickup in spite of the fact that the permanent magnet synchronous motor is incapable of running at reduced speed without stalling. Examination of the rotor under conditions of increased mechanical load show that it is still revolving at exact synchronous speed. The slowing down of the platen is caused entirely by belt slippage.

The accuracy of the diameters of the belt surface of the platen and of the drive pulley are kept to a sufficiently close tolerance that the speed from one turntable to another is always within 0.16 per cent (sixteen hundredths of one per cent). This alone does not ensure speed accuracy, because of the element of belt slippage. The actual turntable speed is partly determined by the friction between the belt and the drive surface.

A calculation of the diameter ratio between the belt surfaces of the pulley and of the platen would show that the pulley diameter is slightly smaller than the exact speed ratio indicates. With the correct calculated value the turntable will run too fast.

It may seem illogical that belt slippage will cause a turntable to run fast, yet this is what happens in the typical belt-drive system. The drive pulley revolves in jerks from one motor pole to the next, and the instantaneous speed of the pulley is at times greater than its average speed. The belt filters out the roughness and picks off an effective speed which turns out to be slightly higher than the average.

Flutter

There appears to be unanimous agreement among academic authorities that raw flutter readings (per cent frequency deviation) have limited meaning until they are qualified by information on flutter rates.[10] All of the writer's experience in development work on the AR turntable bears out this conclusion. The statement that turntable X has flutter of 0.1 per cent and that turntable Y has flutter of 0.2 per cent does not reveal which of the two turntables has better flutter performance. If the 0.1 per cent deviation occurs at a flutter rate of 3 cps, and the 0.2 per cent deviation occurs at other rates, the turntable with the higher raw flutter may have a lower flutter index. Since its flutter has less nuisance value it obviously deserves a superior flutter rating.

In spite of the above considerations, turntable performance continues to be described in terms of per cent raw flutter. The meaning of this number is easily understood, but it may have little aural significance by itself.

Although the AR turntable does conform in flutter performance to the 1953 NAB Standards of Good Engineering Practice for broadcast equipment, which are in terms of raw flutter, (the flutter measurements yielded results closer to the recording rather than the reproducing figure), the significant production line testing at the AR plant is performed by a weighted flutter meter whose indications take into consideration the instantaneous flutter rates, and are actually in terms of an aurally significant flutter index. This flutter index is a unit somewhat similar to that suggested by the American Standard[11] referred to previously.

Rumble

As in the case of flutter, rumble continues to be described inadequately, in terms of raw amplitude below a given reference level without consideration for the frequency distribution of the rumble energy. The frequencies in the rumble signal may be subsonic, in the 30-cps range, or as high as 120 cps. The difference in perceptibility between 10-cps rumble and 30-cps rumble is tremendous. (It is assumed that the rumble amplitude is low enough so that it does not significantly load the amplifier.)

The AR turntable meets the NAB rumble standard, but more significant information in production line testing is provided by a rumble meter which is weighted according to the frequency characteristics of hearing sensitivity.

Both of these testing functions—providing weighted flutter and weighted rumble readings—are performed by a DataService Corp. flutter and rumble meter, model FM-3.

Correlation between the test information given by this meter and standard flutter meters is relatively low. Correlation with simple listening to a 3000-cps flutter record is excellent. The latter is a particularly good test method when several turntables are being compared, providing information of much greater significance than that of a raw flutter reading. No turntable or professional tape machine to the writer's knowledge, is capable of reproducing a 3000-cps pure tone in a reverberant room in such a way that flutter cannot be readily heard, but it is relatively easy to compare the flutter effect of different reproducing machines. It should be remembered that very slow flutter corresponding to one change per revolution at 33⅓ rpm (0.55 cps) is much less annoying in music than flutter whose rate centers around 3 cps.

The flutter index in the AR turntable is kept to low values through the use of the simplest possible one-step drive system, mounting of the tone arm for minimum warp wow, machined drive pulley and platen, machined bearings, and possibly most important of all, a precision-machined belt (machined after freezing). Most of these features are common in turntables in which professional performance standards are sought.

Correlation between the weighted rumble information provided by the DSC meter and NAB ratings is also low. Correlation with listening tests in which different turntables are compared—using the same "quiet groove" record, pickup, and reproducing equipment—is excellent. Two turntables with the same NAB rumble rating may be miles apart on a rumble listening test. The weighted rumble in the AR turntable is kept to low values through the use of low-speed motors, compliant belt drive, isolation of the rigid platen-arm assembly from the motors, and a machined platen bearing.

Safety and Convenience

The AR turntable is supplied with its wooden base and transparent plastic dust cover included. If this turntable were sold without the base, Underwriter's Laboratories approval, which has been applied for, would not be available. UL approval requires that the moving parts and electrical terminals be safe from prying fingers. The individual electrical components used in the AR turntable, from motors to power cord, already have separate UL approval.

A dust cover seems a logical and intrinsic part of a record player. The convenience from the housekeeping point of view is obvious, but more important, the turntable mat is protected from dust which can transfer to the record.

Fig. 8 illustrates the complete unit. Æ

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[10] *Op. cit., JSMPTE* and Z57.1-1954.

[11] *Ibid.*

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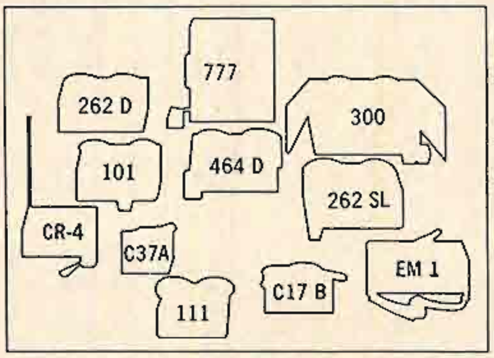

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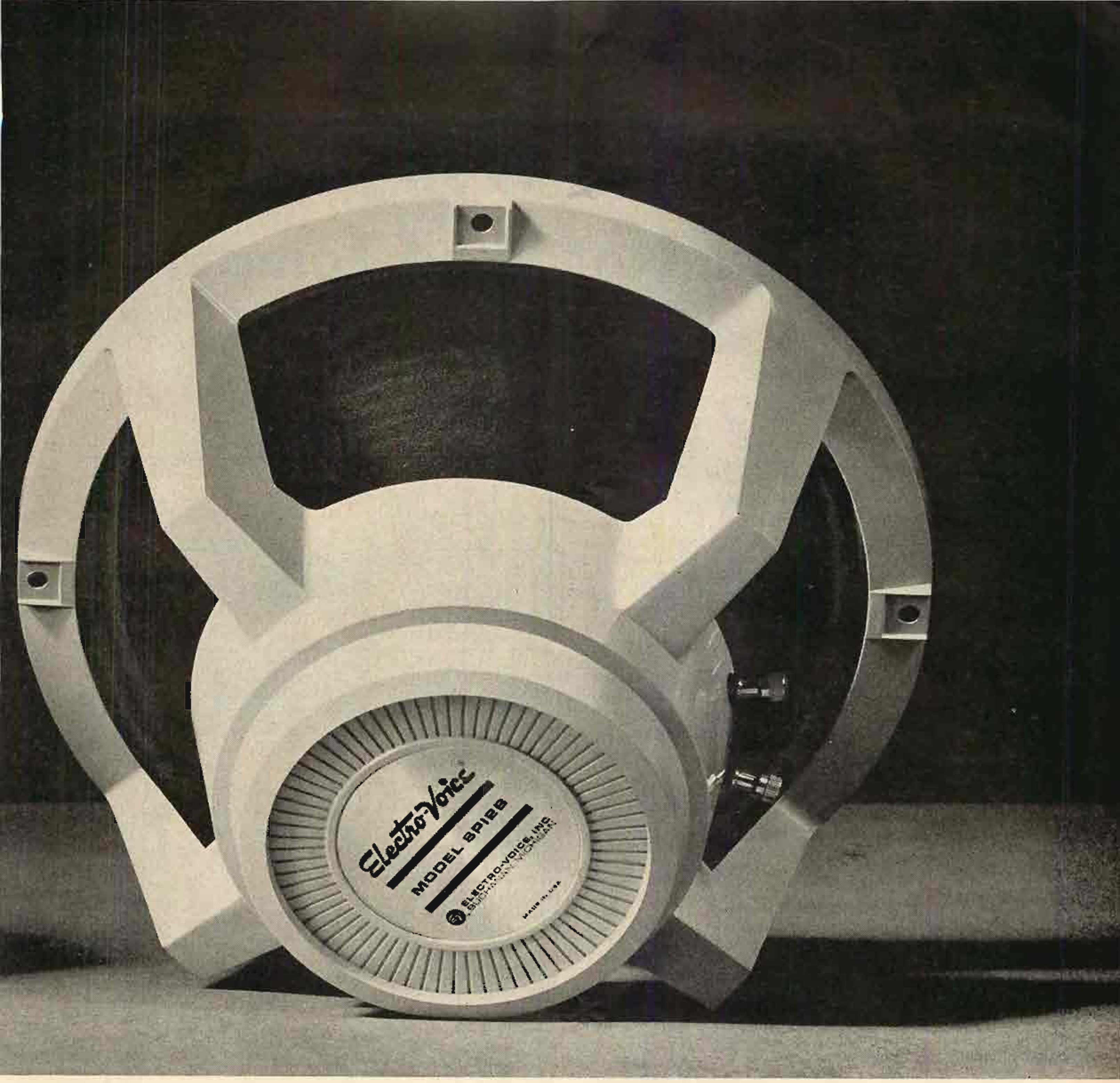

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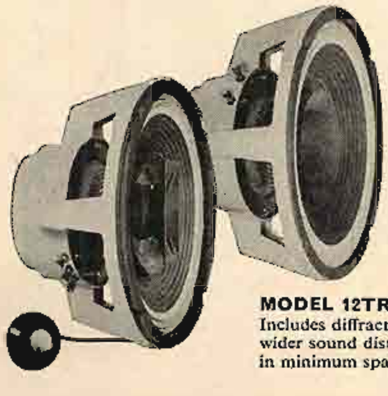

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Prelude for the Well-Tempered Clavichord, Not Well Tempered

A recording is made on magnetic tape for the purpose of comparing the tempered and just intonations

HAROLD TORNHEIM*

A controversy has quietly raged for more than two hundred years among musicologists over how the scale should be tuned. Hints of this situation even appeared this year in the pages of Audio[1,2,3,4]. The controversy long ago had degenerated into a stalemate because the construction of keyboard musical instruments did not allow a fair comparison of the tunings. But technology has now reached a stage in which we have electronic organs and magnetic tape recorders, and these in their existing forms can unblock the stalemate.

The controversy is over the answer to the question: should the scale be tempered or just? Or, in another technical language, should the relative frequencies in the scale be in ratios of powers of the twelfth root of two (which is the tempered intonation), or in ratios of small whole numbers (which is the just intonation)?

The proponents of the tempered intonation have the advantage that this is the intonation in universal use. They contend that it is the only practical way. Their arguments often follow this pattern: There appears to be no limit to the number of frequencies per octave required by the just intonation. Perhaps an infinity of frequencies is necessary. For artistic purposes man must limit this infinity somehow. Any such limitation is arbitrary. Our culture is satisfied with just twelve frequencies. The limitation to twelve is not a shortcoming: it is a tremendous accomplishment. It is man's ingenious solution to coping with nature's infinite variety. As for beats, which are ever present in the tempered harmony, they are akin to vibrato, that intentional frequency modulation which a violinist, for example, produces to give life to the tone. The musical art would not be what it is if it were not for the tempered intonation.

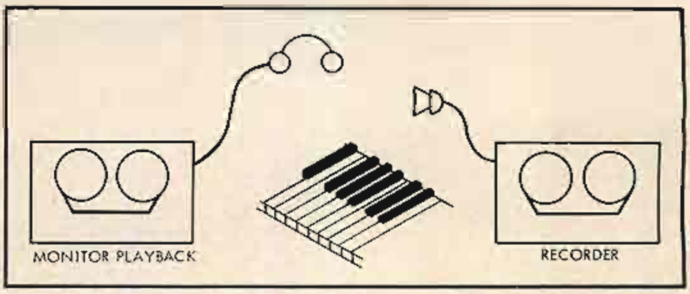

Fig. 1. Setup for maintaining tempi in the just intonation recording by monitoring the tempered recording.

The proponents of the just intonation can reason equally well, stating that the tempered intonation is indeed a shortcoming; that the limitation to twelve frequencies is analogous to the limitation to three colors imposed upon the artists who draw the comic strips in the Sunday newspaper. These artists, with less than twenty hues derived from these colors, have developed a remarkable ingenuity also. Nevertheless, their works are not equal to paintings which are not so restricted, but we would not know this if all paintings had to be produced by newspaper printing presses. As for vibrato, one of the reasons that this gives life to the tone is that at times in the frequency excursions the harmony comes into the tune in the sense of the just intonation.

At this point the proponents of the just intonation have wished that they could verify their arguments with a demonstration, and the proponents of the tempered intonation have rested smugly with the knowledge that such a demonstration was impossible. The tempered intonation has already produced the best in music; the just intonation in competition must produce better.

I have already indicated that such a demonstration is now possible with modern technology; furthermore, I have recorded such a demonstration on magnetic tape. The demonstration, of course, must be the rendition af musical composition. To be effective the composition should be widely accepted as good music and should be chosen by a proponent of the tempered intonation as not qualified for just intonation. Therefore, I chose the composition; J. S. Bach, "Prelude for the Well-Tempered Clavicord in E Flat Minor," Book I, Number 8. A more complete set of reasons for the choice is as follows:

1. The title specifically states that this composition is intended for a well-tempered instrument. (In this article "tempered" and "well-tempered" are synonymous.) The composition was written at a time when the tempered intonation was not yet completely accepted. We call attention to the demonstration by the seeming perversion that the title creates.

2. The composition is written in a minor key. The ratios of the major scale are so much discussed that we may forget that the minor scale might not take care of itself.

3. The composition is marked by incessant transition among musical keys (musicians call this "modulation," but I am avoiding the term in this sense because of the possibility of ambiguity). This makes it all the more discouraging for production in just intonation.

4. The composition confines itself to the four middle octaves, from E-flat below low C to C above high C. This is a mitigating circumstance since a piano was the musical instrument in the first recording. The characteristic of the harmonics of the tones of a piano to be out of tune is more pronounced in the low register. An organ does not have the problem of harmonics being out of tune. The reason why an electronic organ would be better than a conventional organ will appear shortly.

The technique which produces a composition in just intonation is to retune

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** 3627 San Gabriel Lane, Santa Barbara, Calif.*

[1] D. Wolkov, "Electronic organ tone generators," Audio, February, 1962, p. 34.

[2] R. H. Dorf, Letter, Audio, March, 1962, p. 6.

[3] D. Wolkov, Letter, Audio, April, 1962, p. 6.

[4] G. S. Spratt, Letter, Audio, April, 1962, p. 6.

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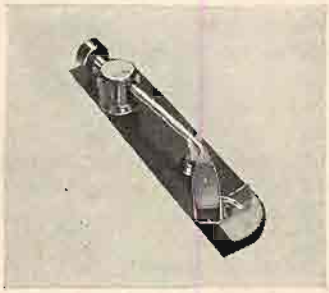

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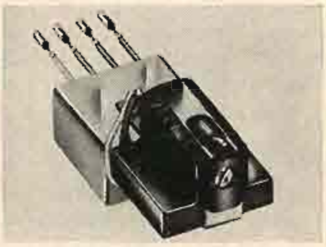

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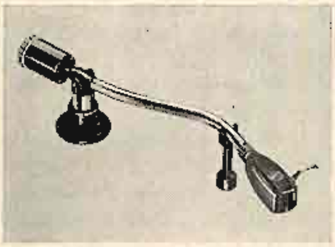

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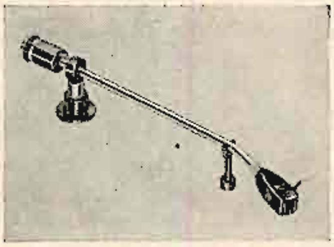

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the musical instrument whenever necessary and to record the passages on separate pieces of tape. Then all of the recorded passages are spliced together to form the complete composition. This procedure does not subject the musical instrument to a design for certain frequency ratios, since any frequency ratio is available which can be obtained by the method of tuning. Furthermore, the personal interpretation of the musician is not lost, because he performs with the same expression as he does for the tempered intonation. Since he repeats the composition, at least in sections, for each retuning, he must take care that he also repeats the tempi. To assure this, I recorded my performance of the Prelude in tempered intonation, and then I played each passage in the just intonation while listening with earphones to the tempered recording on a monitor playback. The setup is shown in *Fig.* 1.

The first step in the over-all process is to study the composition from the viewpoint of a just intonation and to write down in a systematic way the ratios that are called for, for all notes. No thought should be given to whether or not the musical instrument is capable of producing these ratios; as we have seen, it can produce them.

There is some freedom in the choice of the ratios. They can be made so nearly like the tempered intonation that only the beats are eliminated. They can deviate further to call attention to differences in character in the transitions from one musical key to another. They can deviate still further to evoke harmonies of which the tempered scale is incapable, and thus change the character of the passage. In the demonstration, I chose the middle course.

Tuning is done not in the customary way by ear, but with electronic instruments: a microphone to pick up the sound, an oscilloscope to display the frequency ratio, a stable variable audio oscillator, and a reference tuning fork. For the Prelude the reference tuning fork was the tempered E-flat. The frequency of the fork is introduced to the vertical deflection terminals of the oscilloscope while the output of the oscillator is set to trigger the sweep at an appropriate frequency ratio, a setting so precise that the pattern on the oscilloscope does not drift.[5] Then the sound of the musical instrument substitutes for the sound of the fork, and the frequency of the instrument is tuned to conform. The setup is shown in *Fig.* 2. By this method, for example, a specified ratio of 19/16 was precisely tuned, notwithstanding the fact that 19, a prime number, is reaching the limit of small numbers required by the definition of just intonation.

The composition, performed on the identical musical instrument by the same musician in tempered intonation for comparison, must also be as precisely tuned with the same electronic instruments.

The reason for preferring an electronic organ to a conventional organ now becomes apparent. An electronic organ has few generators to tune, and they are easier to tune. Furthermre, it is possible to eliminate the frequency response of speakers and microphones and the accoustics of the room by coupling the recorder directly into the musical instrument.

The systematic tabulation of the ratios for the just intonation of the Prelude showed beforehand that the execution on tape would give rise to the following data. The piano was retuned to seven musical keys. The piano was retuned nine times, since sometimes there was a conflict within one key regarding what a specified note should be. From the resulting nine pieces of tape, one for each retuning, 37 passages were cut and spliced together to complete the work. There are 44 frequencies per octave, averaging nearly four frequencies for each note of the scale. The entire Prelude takes three minutes.

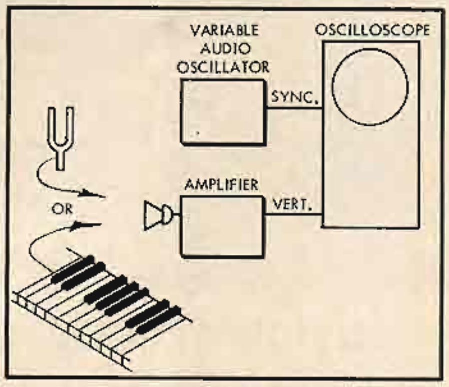

Fig. 2. Setup for tuning the instrument to the just intonation.

Musicians know that the most common transition from one musical key to another is by the third-harmonic frequency ratio. Among the seven keys this occurs four times. One of the remaining transistions is by the next prime number, the fifth harmonic, and another is by the following prime number, the seventh harmonic. These six transitions are the minimum number needed for the Prelude, and all of the others can be derived from these six. It happens that two of the keys bear the same name, but they are not identical; their frequency ratio is 63/64.

The first complete tape for the Prelude was prepared on a non-professional recorder as the recording of a piano. It was an experiment; unforeseen obstacles could have put an end to the entire project. Success of this phase makes the next step simply and obviously a repetition on high-quality recording equipment as the recording of an organ, a recording which can face criticism.

A number of people have listened to the comparison and all have shown a preference for the just intonation. There are too few people so far to make general statements of their impressions. For one thing, there were varying degrees of familiarity with the composition. That there is a difference in the just intonation seems to be apparent immediately. The tempered performance, next heard, is evidently inferior, but as the composition progresses, it sounds better as one quickly forgets how the just intonation sounded. This is a consequence of our thorough ingraining with the tempered intonation. It requires repeated auditions of the two intonations to acquire a familiarity with each one and to surmise why there is a difference in quality.

I can give my reaction. Because it is a piano, a marked reduction in beats did not occur; instead one set of beats was substituted for another. I felt that the just intonation placed the frequencies more where they belonged. It happens that I play a symphony string bass as well as the piano, and I have become accustomed to modifying the frequency of a note to where it pleases me. The music in the tempered intonation sounds as though it is a few steps removed from the music produced by some ancient clavichords and some modern electronic organs in which certain combinations of notes cannot be played together. The construction of these instruments makes it impossible to produce harsh dissonances, but it also eliminates desired and pleasing dissonances. The tempered intonation is rigidly fixed to the twelve frequencies, which at the same time are indefinite enough to belong to all musical keys, whether or not this is desired. The tempered chords have a way of always being in tune even though one might not know in which key each belongs.

The Prelude is unique only because it is in just intonation. Other compositions just as easily can be converted into just intonation. The important implication here is that this might be opening a way for the future development of the musical art. It is admittedly an awkward way of making music, but because of it composers may find enough encouragement to write for the just intonation compositions which are impossible in the tempered, the reverse of the present situation. Also because of it some inducement may be given to the development of musical instruments which can be played in the just intonation in the conventional way without the intervention of the recorder. These instruments undoubtedly will be electronic because of the complexity, and electronic musical

(*Continued on page 98*)

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[5] Kraxberger, "Accurate frequency measurements," *Tektronix Service Scope*, no. 11, December, 1961.

where high fidelity means musical accuracy

Musicians and production personnel are listening to a tape master they have just recorded for Connoisseur Society. The record will be **Flute Concertos of 18th Century Paris, CS 362.**

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The turntable platter will be a one-piece, machined casting, 12 inches in diameter. It will be driven by either a 4-pole induction motor or, in more costly units, by a hysteresis-synchronous motor — a Papst motor, in all probability. And if the turntable has been made ready for use, it will be equipped with a fine transcription arm.

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Had the Miracord gone no further than turntable, motor and arm, it would have achieved distinction as a manual turntable. But, the greater need was for an instrument of turntable-caliber that would also provide automatic record-handling facilities. The need, in short, was for a manual turntable that could be played automatically.

C. G. McProud, noted audio authority, touched upon this in the February, 1962 issue of Audio Magazine:

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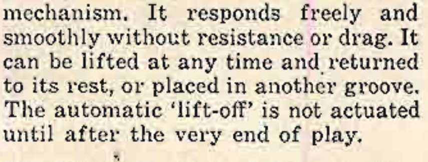

A Condenser-Microphone Mixer

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When more than one microphone, or more than one signal input per channel is employed during a recording process, it is normally necessary to provide a mixer of some type to attain the desired balance between the individual inputs. In the case of microphones, the low level of signal output dictates considerable amplification in addition to the required mixing process. Commercial microphone mixers, therefore, provide both functions: amplification and mixing. However, if it is desired to add a high-level signal source other than the microphone, the amplification of the microphone channels will be too great, and since the gain control is usually located *after* the first stage of amplification, severe overload will occur. It is for this reason that mixers have separate inputs for low-level and high-level signals. An example of such a mixer is shown in *Fig.* 1. Each recording channel has a total of six inputs: four low-level microphone inputs and two high-level inputs. This is the standard type of configuration and the low-level gain is based on typical low-level outputs from microphones such as the dynamic and the ribbon. But what about the condenser microphone? And what about the re-recording process where all inputs may be of high-level origin? Since the output of the condenser microphone is high in relation to that of the dynamic, it will cause overload when connected directly to the standard microphone mixer, and is usually attenuated by resistive padding prior to the mixer input. This will, of course, solve the gain problem but requires the signal to undergo *two* critical low-level high-gain circuits: one in the preamp of the microphone itself and one in the (dynamic) mixer. Because the gain in the mixer is being controlled after a "wide open" first stage, the signal-to-noise ratio of the mixer is a function of the level of signal input and cannot be helped by the gain control in the event of low signal input. A gain control within the resistive padding between the microphone and the mixer, however, would increase the signal input and the signal-to-noise ratio. The major disadvantage to this approach is, again, the danger of overload with higher level signals unless the pad is operated as an additional mixer control. It is obvious that a fixed resistive padding must be a compromise between a low-level signal that would degrade the mike signal-to-noise ratio, and a high-level signal that would overload the mixer input stage. In any event, this padding procedure is a corrective action to remedy an *incompatability* between a microphone output and a mixer input.

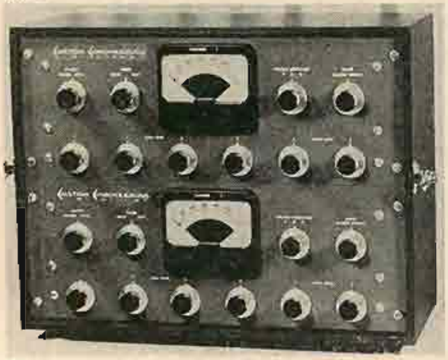

Fig. 1. A standard mixer which accepts both low-level and high-level signals.

Design Considerations

While the standard approach of padding condenser mike outputs for use with dynamic mike amplifiers is normally satisfactory for most operations, it does require the use of separate amplifiers (or additional positions) for high-level mixing. This, in turn, represents additional expense to the user. From the foregoing, it would appear desirable to take advantage of the higher output of the condenser microphone and obtain more flexibility from the mixer itself. This is easily accomplished by eliminating the first stage of the conventional amplifier and placing the gain control at the input.

The mixer to be described was designed to provide the following: *six inputs* usable for either microphone or high-level; *outputs* either stereo or mono, to two-track recorders; *frequency response* flat from 20 to 20,000 cps (for use in sound reenforcing).

Determination of the required gain was based upon use of Newmann U-47 microphones and an Ampex 354 stereo recorder. In order to prevent overload within the microphone preamplifiers, they were internally strapped for a source impedance of 200 ohms and terminated into a 150-ohm winding of a mike-to-grid transformer (see *Fig.* 2). The required output of the mixer was determined to be one volt working into an impedance of 100k ohms. Distortion and signal-to-noise ratio, of course, should be equal to or better than comparable commercial units.

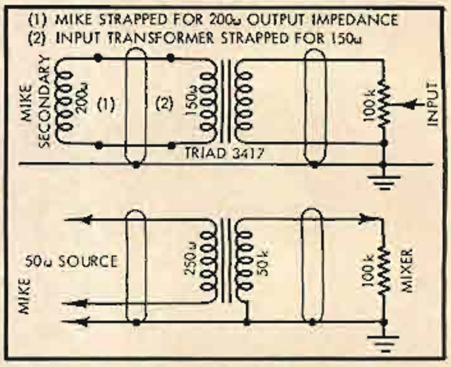
(1) MIKE STRAPPED FOR 200Ω OUTPUT IMPEDANCE
(2) INPUT TRANSFORMER STRAPPED FOR 150Ω
MIKE SECONDARY
200Ω
(1)
(2)
150Ω
TRIAD 3417
100k
INPUT
50Ω SOURCE
MIKE
250Ω
50k
100k
MIXER

Fig. 2. Schematic of two methods of connecting microphones to preamps.

Circuit Details

The circuit (see *Fig.* 3) is a three-stage resistance-coupled design with the first stage providing voltage amplification, the second stage providing mixing through plate coupling of the individual positions, and the third stage providing a low-impedance output with a cathode follower.

Two separate channel outputs are provided with a plate coupling switch determining whether all inputs are mixed as one channel through two identical outputs, or three inputs of each channel are mixed separately to two different outputs. The first condition provides a mono recording on two-track recorders, while the second condition provides a stereo recording.

Large amounts of cathode feedback are employed for low distortion and uniform frequency response. For uniformity of gain and ease of coupling, separate plate and cathode resistors are used in the second-stage mixers and sep-

* *577 East Avery St., San Bernardino, Calif.*

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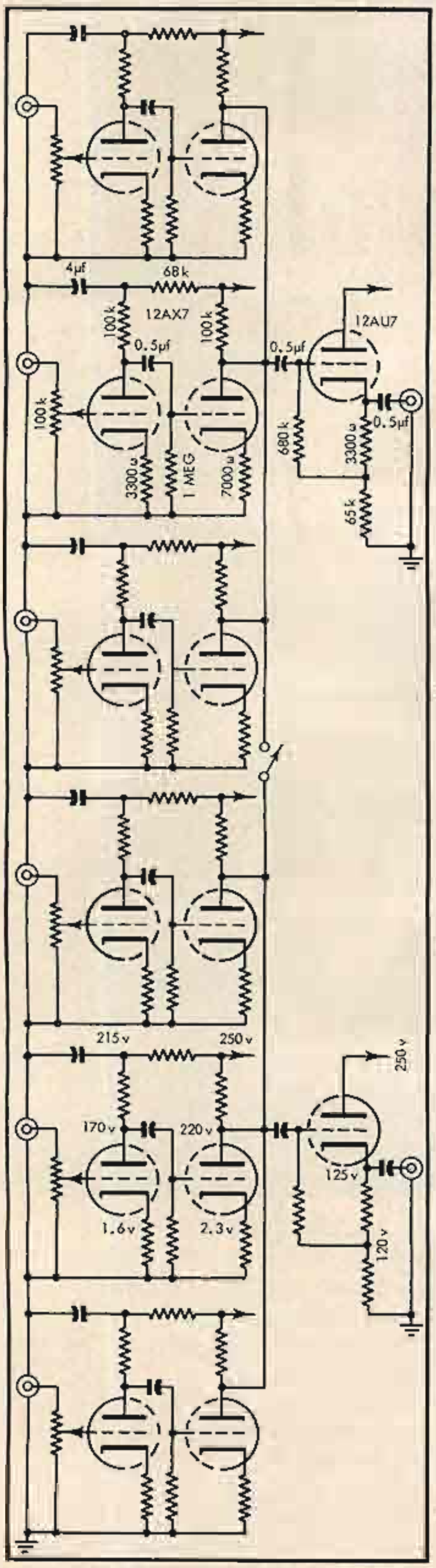

Fig. 3. Schematic of condenser microphone mixer.

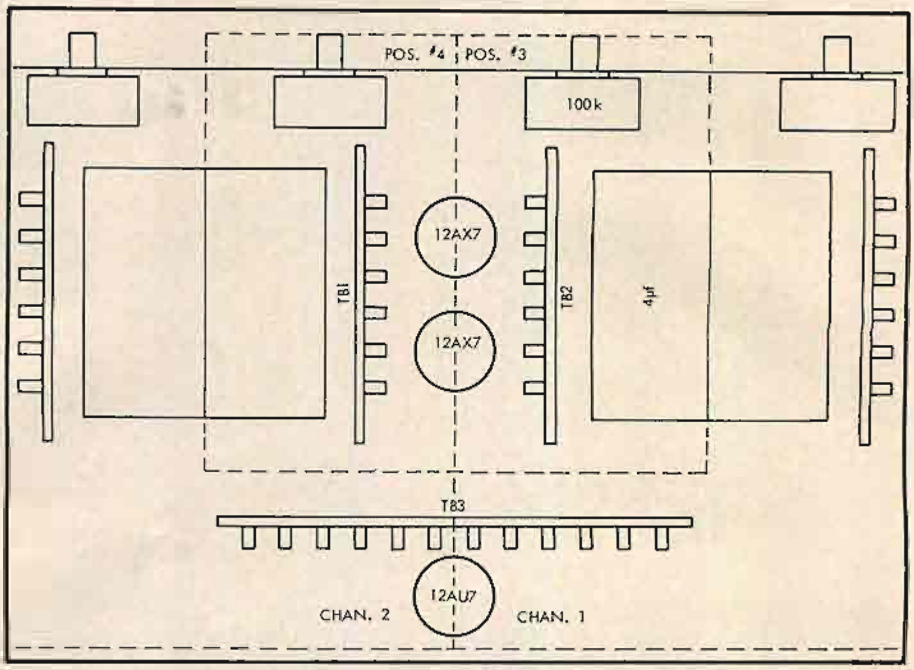

Fig. 4. Schematic layout of amplifier-mixer board.

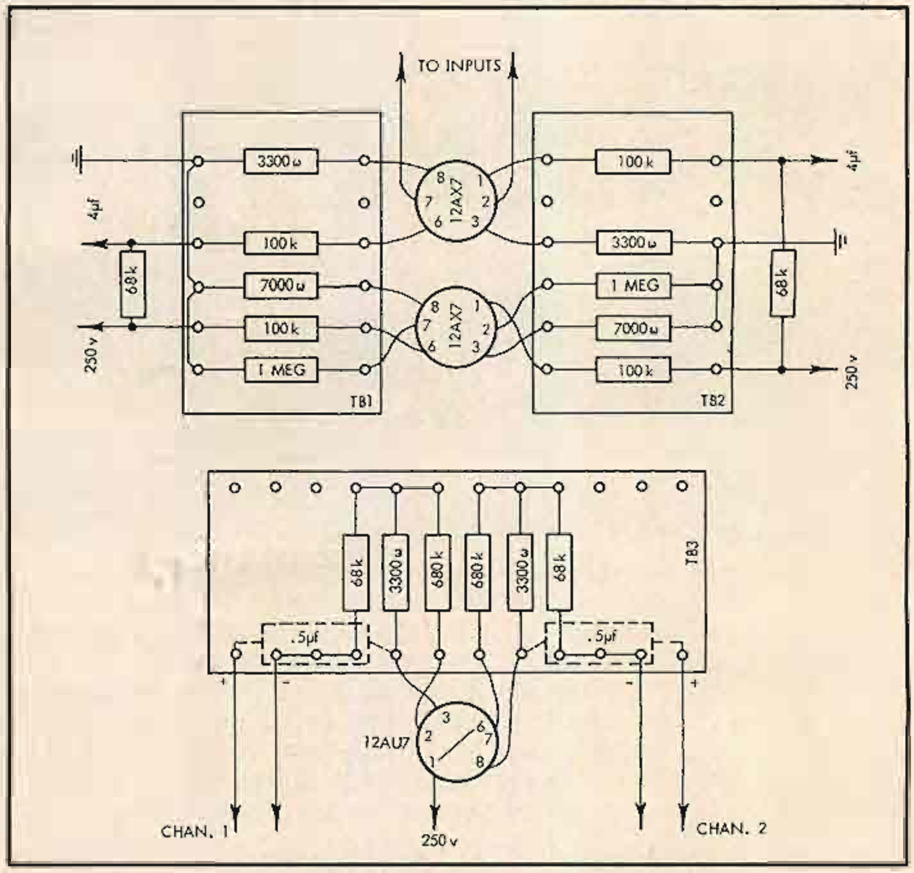

Fig. 5. Layout of amplifier-mixer board.

arate filtering is provided for the first stages. The coupling capacitor values are all high to permit good low-frequency response with minimum phase shift, and the plate circuit switch is relay actuated to allow the switching to occur at the tube. This provision eliminates hum pick-up for high-frequency losses resulting from lead lengths to and from a manually operated switch.

Layout

The design lends itself well to terminal board construction and the complete mixer electronics (less power supply) can be obtained with only three terminal board circuits: two for the amplifier-mixer section and one for the cathode follower tube. Each amplifier-mixer board contains the circuit for one position and varies only with respect to whether it is on the right or the left side of the tubes (see *Fig.* 4). The layout for these terminal boards is illustrated in *Fig.* 5 and three each are required of TB1 and TB2 and one of TB3. A distinct advantage of this type of layout is that little chance of circuit performance deviations exists, irrespective of who builds the circuit.

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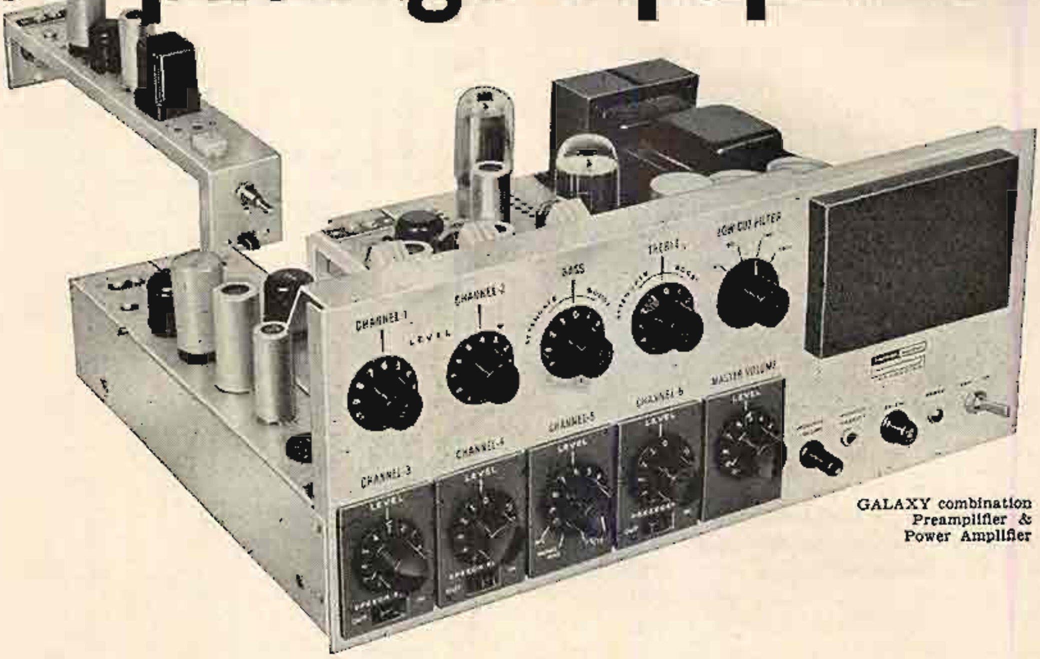

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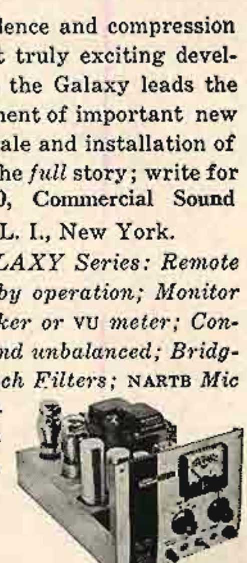

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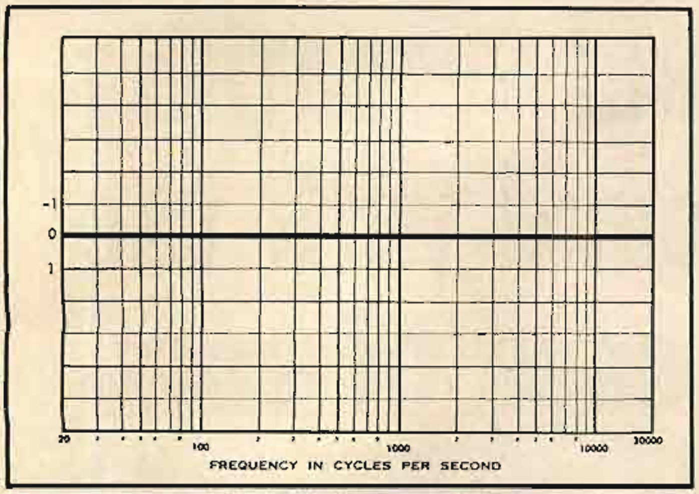

Fig. 6. Frequency response of mixer at 1 volt.

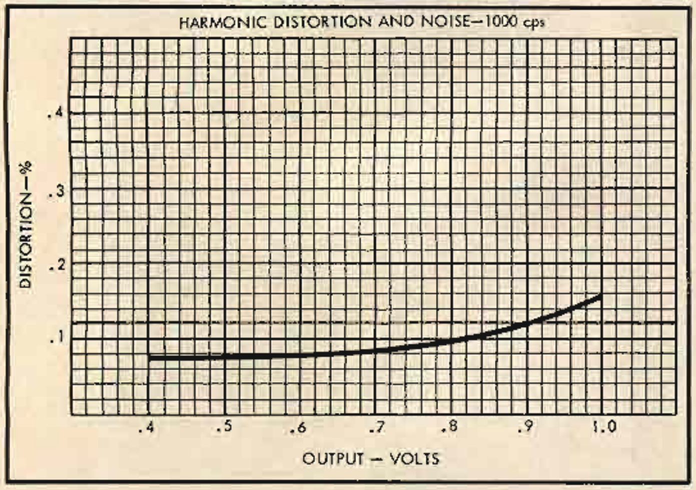

Fig. 7. Harmonic distortion for worst case.

Construction

To facilitate either portable or rack use it was decided to use standard rack construction and, since the author already had a separate regulated power supply that powers the unit shown in *Fig.* 1, to make the mixer a separate unit.

Upon completion of the terminal board construction and assembly, layout was effected on an aluminum chassis measuring 3″ × 17″ × 8″. In order to keep down the over-all height of the unit, it was necessary to cut holes in the chassis to minimize capacitor height. Each capacitor was anchored approximately half above, and half below the chassis top. After all chassis holes were cut, hardware attached, and heaters wired, the gain controls were installed and wired to the input jacks with shielded cable. The amplifier terminal boards were then installed, wired, and the coupling capacitors between the first two stages connected between the tube sockets. Next, the cathode follower terminal board was installed and wired, followed by the insertion of the coupling capacitors between the mixer output and the cathode follower. All B-plus and ground connections were then completed. The final layout, both front and bottom is shown in *Fig.* 13 and *Fig.* 14. Two items in the photos are associated with this particular unit only, and do not show in the schematics: The three black capacitors shown in the bottom view are a part of the power supply used, and a double throw plate sensitive relay is used to couple the plate circuits of the two channels and switch the indicator lights shown on the front panel.

Inasmuch as the microphones are used in conjunction with more than one mixer, the mike transformers are on the line rather than in the mixer, but ample space is available for installation of transformers on the chassis in place of the present power supply (heater) components. The inputs are shorting type phone jacks, the outputs are Cannon two-terminal connectors, and the power inputs are Cinch-Jones plugs.

The front panel is a standard rack panel that is 5¼″ × 19″, with identification and marking done with decals.

Performance

Test performed with the completed mixer indicated the following:

1. Frequency response flat to 20kc (see *Fig.* 6)
2. Harmonic distortion (see *Fig.* 7)
3. Hum and noise better than 75 db below one volt for 20 millivolts input to one position.
4. Sensitivity 20 millivolts for one-volt output.

Harmonic distortion was measured for the worst case: that of one output only, and will be less when more than one input is used. The sensitivity was also measured with only one input (in the stereo position) and with three inputs, the sensitivity per input for 1 volt output would be 6.6 mv. A single 10-mv input (stereo position) gives an output of 0.5 volt at less than 0.1 per cent harmonic distortion and noise.

Both distortion and noise were of such low magnitude that difficulty was experienced in measuring them and the curve is shown, not to provoke discussion relative to the measuring equipment or procedures, but to indicate only that the values *are* low.

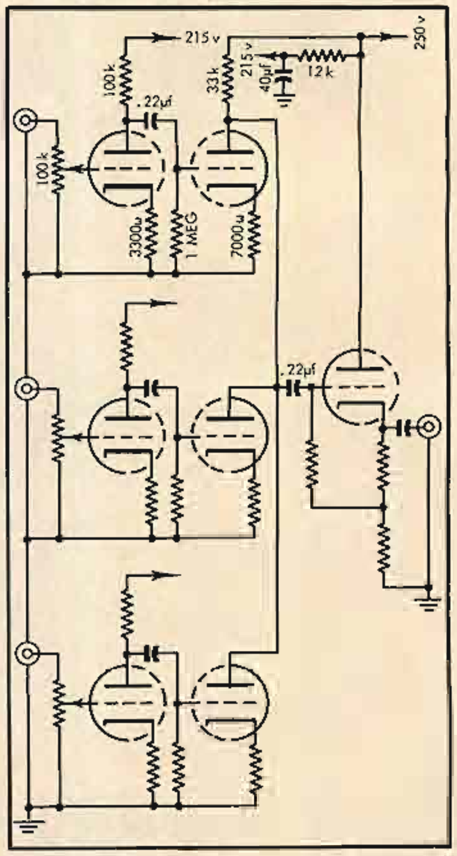

Fig. 8. Schematic of less expensive and more compact unit.

Circuit Variations

For those who may like to construct a cheaper and more compact unit, an alternate circuit is given in *Fig.* 8. This circuit (only one channel shown) is essentially the same electronically, but omits a number of components in the original circuit by making the power supply decoupling and mixer plates common. Making the B-plus supply common to all first stages eliminates five capacitors and five resistors, and using common plate resistors in the mixer stage eliminates five more resistors. This circuit also implies the elimination of any oil-filled capacitors, the 40-µf decoupling capacitor is intended to be an electrolytic.

For those who should decide that they might go a step farther with the elimina-

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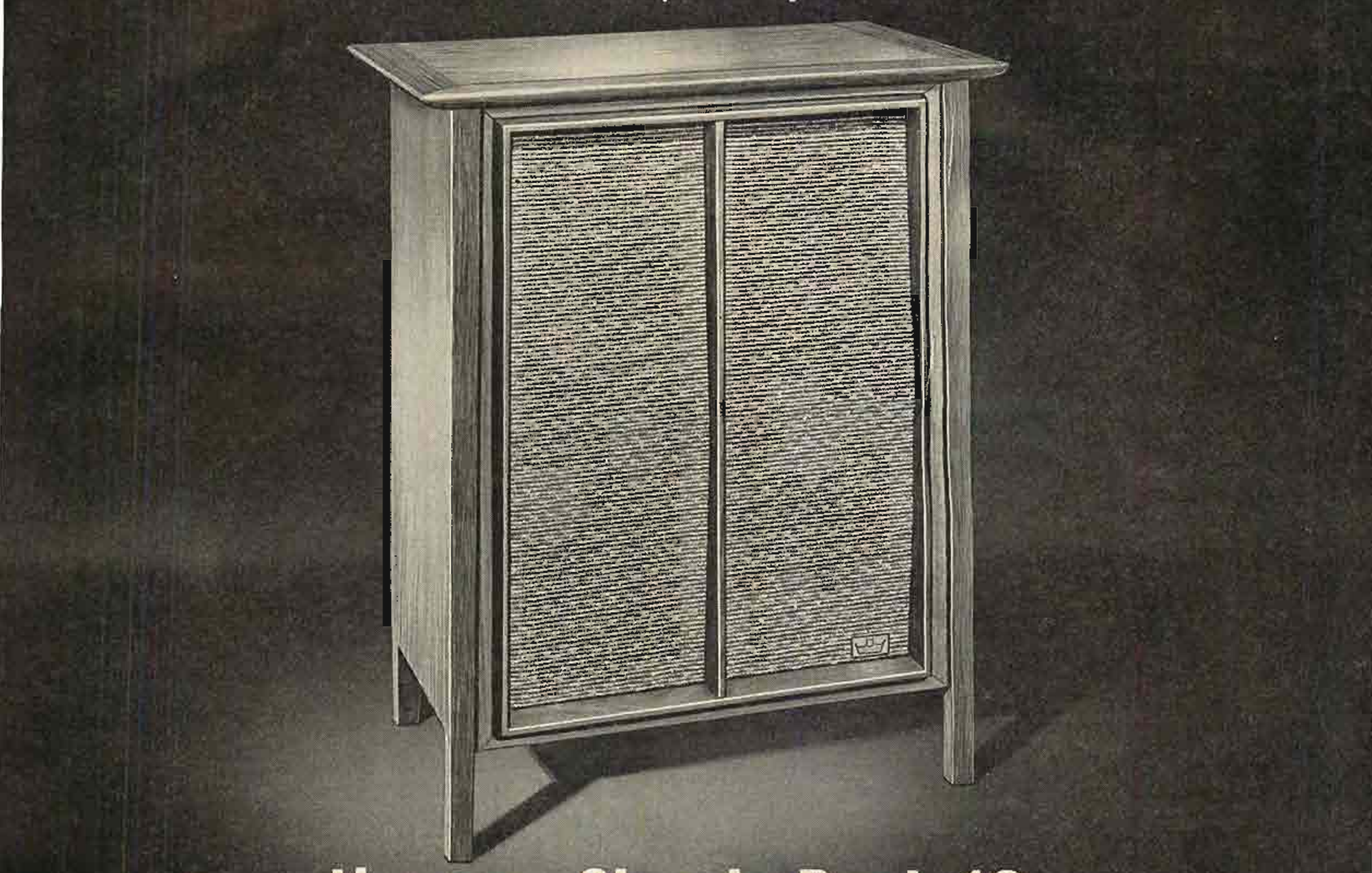

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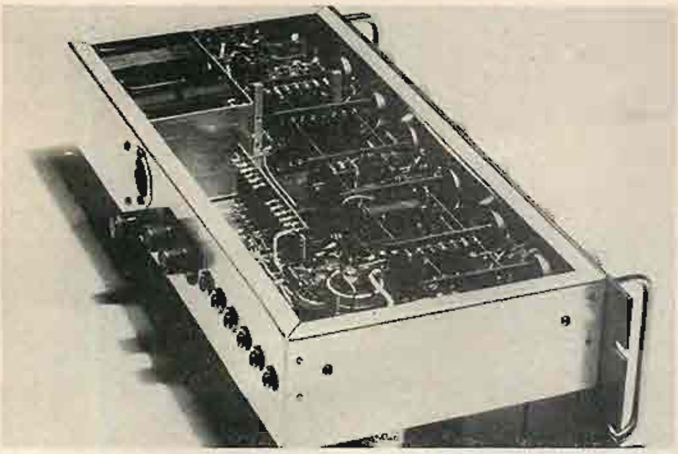

Fig. 9. View of economy unit with power supply built in.

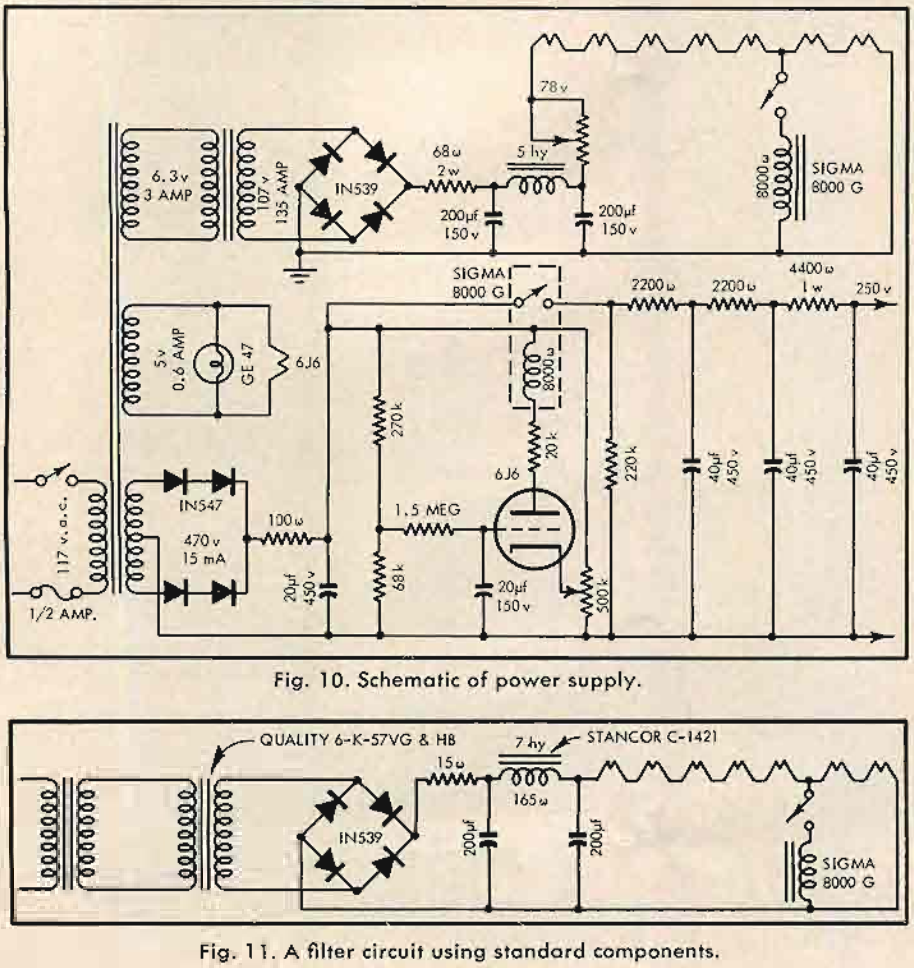

Fig. 10. Schematic of power supply.

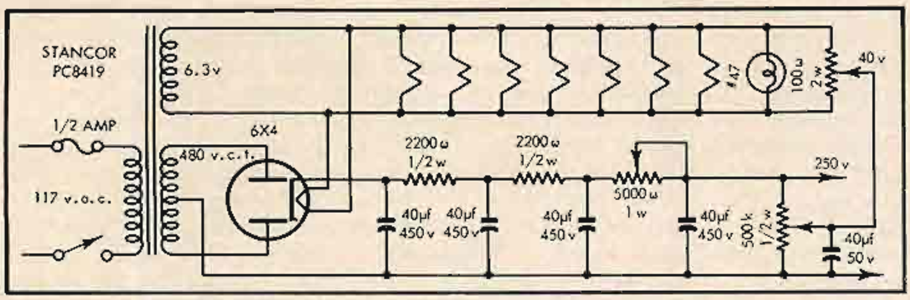

Fig. 11. A filter circuit using standard components.

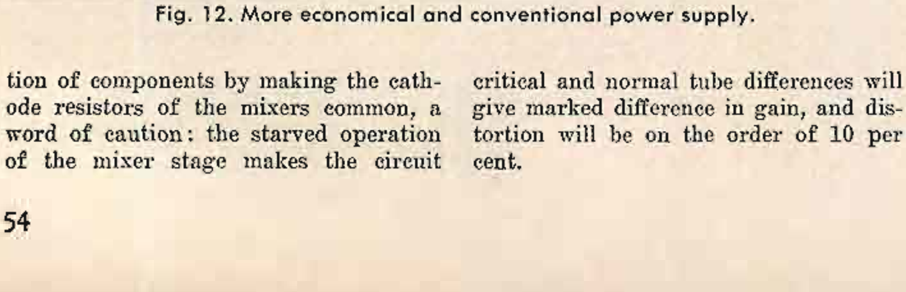

Fig. 12. More economical and conventional power supply.

tion of components by making the cathode resistors of the mixers common, a word of caution: the starved operation of the mixer stage makes the circuit critical and normal tube differences will give marked difference in gain, and distortion will be on the order of 10 per cent.

The large values of coupling capacitors are not necessary to obtain the required frequency response (used only to minimize phase shift at the lower frequencies) and standard coupling values may, of course, be substituted. Some low-frequency instability was encountered (at approximately 5 cps) with this circuit when coupled with an integral power supply, and the coupling capacitors were, therefore, changed to 0.22 µf. The response, however, *still remains* flat below 20 cps.

Power Supply

Since the regulated power supply used for the initial unit was designed to provide up to 150 ma, and would be uneconomical for this application, no details will be given. Another complete mixer using the circuit of *Fig.* 8 was constructed by the author. This unit contains an integral power supply, in the same size chassis as the original, with room to spare (see *Fig* 9). The circuit of the power supply is given in *Fig.* 10. High voltage is provided by a full-wave silicon diode circuit, through a time delay circuit, that allows approximately 40 seconds prior to closing the main B-plus relay. This delay eliminates the initial voltage surge prior to tube heater warm-up and in addition to providing increased component life allows the use of smaller sized capacitors in the front stages of the amplifier. A.c. voltage from the 5-volt winding supplies the pilot lamp and the heater of the time delay triode. A full-wave bridge circuit provides d.c. voltage for all tube heaters and the mixer plate-coupling relay. The delay in the B-plus circuit is determined by the time constant of the R-C network (1.5-meg resistor and 20-µf capacitor) and the bias setting of the 6J6. The optimum setting of the bias would be that voltage that would require a minimum of plate current increase after, or subsequent to, the energizing of the plate-sensitive relay. In this specific case a bias of approximately 5 volts was employed. A suggested procedure for adjusting the time-delay circuit is as follows: turn unit on and allow it to warm-up for at least two minutes with cathode pot adjusted for tube cut-off on 6J6. After voltage has stabilized at the grid, slowly decrease bias by adjusting the potentiometer until the relay activates. This procedure will insure that the capacitor is fully charged and that the tube is fully conducting thereby ensuring a minimum flow through the plate circuit. If the delay time is other than that desired, different times may be obtained by simply changing the bias and/or changing the R-C time constant.

Two non-standard components were used in this power supply: the power transformer and the choke. It is for this

(*Continued on page 101*)

bzzzz

When a very small boy has his hair cut, the clippers make a harsh buzz—a nervous, exciting sound. Yet the same machine gives off only a dull hum when it's used on a man.

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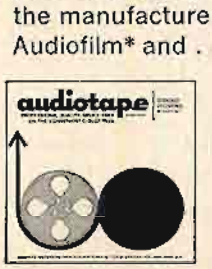

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TAPE GUIDE

(*from page 28*)

to compensate for this. Or if the head provides more than the theoretical amount of response at the very low frequencies, as some heads do, the playback bass boost must be decreased to this extent.

With respect to recording, the NAB standard provides simply that record *equalization* shall be such as to satisfy the NAB requirement with respect to overall response, which is as follows: Response has to be flat within ± 1 db between 100 and 7500 cps; below 100 and above 7500 cps, response may drop more than 1 db, provided that it is down no more than 4 db at 50 cps and at 15,000 cps.

Accommodating a Ceramic Cartridge

Q. At the present time I use a ceramic cartridge and although I plan to buy a magnetic cartridge in the future I do not feel I can afford one now. The input to my tape recorder is designed for a magnetic cartridge and therefore there is a mismatch. I have used a pi network with resistors and capacitors to lower the voltage and to "kill" the heavy treble which is predominant in this cartridge. This works but I do not feel that it is entirely satisfactory. Do you know of a way that I could match this cartridge with my input circuit?

A. It appears that you have two basic problems: (1) You need to convert the output of your ceramic cartridge so that the cartridge simulates a velocity device by producing increasing output with rising frequency; (2) you need to reduce the output level of your cartridge so that it is on the order of a few millivolts, instead of 1 volt or so, in order to avoid overloading the preamp of your tape recorder, which is designed to work with the small signal presented by a magnetic cartridge.

To convert the ceramic cartridge into a velocity device, you have two choices:

1. You can put a small capacitor in series with the hot lead to the cartridge. This capacitor in series with the load presented by the preamp acts as a high-pass filter, which takes care of problem no. 1. The smaller the capacitor, the smaller will be the output signal, which takes care of problem no. 2. Values of 50 to 200 pf are typically used. The proper value, which you can determine through experimentation, is the smallest capacitor which gives you sufficient volume. The trouble with this technique, however, is that it usually leads to treble exaggeration. This is caused by the built-in resonance in the treble range that generally characterizes piezoelectric cartridges. The treble accentuation is required for correct frequency response when the cartridge is used as an amplitude device. It is a nuisance when the cartridge is used as a velocity device.

2. You can load the cartridge with a small resistor wired directly across the output leads and located within the phono arm shell. The piezoelectric cartridge is essentially a capacitance, with typical values lying between 300 and 600 pf, although sometimes going up to 1000 pf or possibly more. This capacitance in series with the small load resistor acts as a high-pass filter. The smaller the resistor, the higher is the frequency through which response continues to rise. On the other hand, you don't want response to rise throughout the audio range, because of the treble accentuation previously mentioned. To offset the treble hump, you want the rising output characteristic to taper off around 5000 cps or so. This can be accomplished by using a load resistor that is small but not too small. The proper value, assuming a cartridge capacitance of about 500 pf, tends to be in the general vicinity of 51k. The larger the value of the resistor, the greater will be the reduction in treble response.

Under the second method, you still face the problem of keeping the output of the cartridge suitably small so that it will not overload the preamp of the tape recorder. This can be easily accomplished by making a voltage divider out of the load resistor. As a rough guess, about one-tenth of the cartridge's output, after conversion to a velocity device, should be fed into the preamp. For example, if the load resistance should be 47k, this could consist of a 42k resistor in series with a 5.1k resistor, with the 5.1k resistor going to ground. Output would then be taken between ground and the top of the 5.1k resistor. If you use ¼-watt resistors, you can find room to place the load resistors within the cartridge shell.

Tape Curl

Q. I have a collection of 4-track stereo tape recordings. One of them, after the recording was played some fifteen times, does the following: The tape jams against the pressure pad and then slides lower and approximately one track-width down on the head, reproducing the lower track with some reproduction in the upper track. This, I find, is caused by the upper edge of the tape being stretched and therefore the tape is pulled tight only across its lower half. This tape winds very poorly. Could this be shrinkage? My 30 other tapes, all kept in the same place under the same conditions, are fine. Can you offer any explanation or remedy for this?

A. The condition you describe is known as curling. It is probably due to faulty slitting on the part of the tape manufacturer. There is nothing you can do about it. I suggest that you contact the company that made the tape recording. Chances are that your tape will be replaced.

Tape Playback Equalization

Q. Can you please supply me with a diagram of a circuit that will produce NAB tape playback equalization, preferably a negative feedback circuit. I would also appreciate an explanation of how such a circuit works.

A. *Figure 1* shows the circuit you ask for. At very low frequencies (below 50 cps), virtually no negative feedback exists between the plate of V_2 and the cathode of V_1, because there is about 630k resistance (R_2 plus R_3) between these points; R_2 is virtually unbypassed by C_1 (0.005 μf) because at the very low frequencies the impedance of C_1 is much greater than the value of R_2 (620k). But the impedance of C_1 becomes equal to R_2 at approximately 50 cps, so that feedback begins to increase appreciably at this frequency due to the bypassing action of C_1. Response is down 3 db at 50 cps due to increased feedback. As frequency rises, the impedance of C_1 becomes proportionately less, resulting in greater feedback and further reduction in response. However, the fall in response due to the bypassing action of C_1 cannot go on forever, because R_1 and R_3 are also in the feedback circuit, preventing the feedback voltage from dropping to zero. The impedance of C_1 becomes equal to that of R_1 plus R_3 (about 10k) at approximately 3180 cps, so that response is within 3 db of its lower limit at 3180 cps. In sum, looking at the response characteristic from the viewpoint of a rise with declining frequency (which is the same thing as a decline with rising frequency), we have a curve that is 3 db up at 3180 cps, continues to rise as frequency drops, and at 50 cps comes within 3 db of maximum response. This is the NAB tape playback curve.

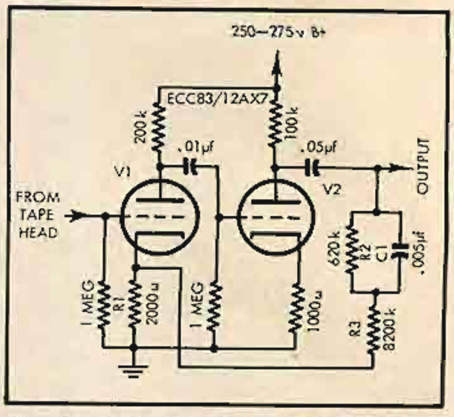

Fig. 1. Schematic of tape-head preamp providing NAB equalization.

Changing Tape Heads

*Q. The following question has perplexed me for some time and since I have no test equipment, I have not been able to find the answer myself. The question arises from the following situation: A tape recorder that I wish to buy is supplied only with ¼-track record and playback. Due to the fact that I wish to use the machine for high-quality mastering work, I would prefer to have ½-track stereo instead of the ¼-track stereo. The question is this: Would I be apt to have an impedance mismatch if I were to remove the original heads (one low-impedance and one high-impedance playback) and replace them with ½-track (stereo) heads. I am not too concerned about the erase head since I generally use fresh tape and also have a bulk eraser. If it will help you, the machine is the * * * *.*

A. First I want to express my surprise that you are not able to buy the * * * * with ½-track heads. My understanding has been that you could get this machine, at least until fairly recently, with either ¼-track or ½-track heads.

Yes, you do run into impedance problems when you change heads, unless you substitute heads of the same type, except for track width, made by the same manufacturer.

In playback, it is likely that the frequency at which treble response starts to drop rapidly will change as the result of cable and other stray capacitance across the head. The head inductance is a determining factor for the frequency at which this drop commences: The higher the inductance, the lower the frequency. Since you already have a high-impedance playback head, it is unlikely that the new head will appreciably reduce the point at which frequency begins to fall. On the other hand, prior to the treble drop there is more or less of a treble peak. This peak is sometimes used by the tape recorder manufacturer to compensate for losses at the extreme high end of the audible range: accordingly, the fall-off occurs beyond the audible range. Use of a different head

(*Continued on page 103*)

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High-fidelity components integrate easily into attractive settings because of their relatively small size and flexibility.

THE STEREO SYSTEM on this month's cover boasts a number of features and solves some commonly encountered problems which are worthy of detailed description. For one thing, visual beauty was placed on a par with the desire for optimum sound, which is ideally suited to a multi-component system because of the inherent flexibility. The components which make up this system and the wall unit into which most of them are placed act, literally, as the focal point of a contemporary living room in the Flushing, New York, apartment of automotive magazine editor Melvin F. Jacolow.

Except for a request by Mr. Jacolow that he retain the James B. Lansing 34001 speaker system which had formed the basis of the owner's monophonic system, audio consultant Alexander Rosner of Forest Hills, New York, was given free rein to choose those components which he felt would add up to listening of the highest order. His choices were a Marantz Model 8 amplifier and Model 7C preamplifier, a Fairchild 412 turntable, SME tonearm and Neumann DST 62 cartridge, a Citation IIIX FM-stereo tuner and, at Mr. Jacolow's request, a second JBL 34001.

While the choice of these speaker systems represented an advantage in that their extreme efficiency—very close to 8 per cent—permitted the use of a quality amplifier rated at just 35 watts per channel, it made difficult the quest for high-frequency units which would complement the excellent low- and mid-range performance of the Lansings.

After considerable experimenting with various tweeters, including a pair of custom made units (all of which failed to fill the bill due to the efficiency problem), it was decided to supplement the Lansings with a pair of Ionovac DuK-15 high-frequency units designed to operate from 3500 to 30,000 cps.

When music in the upper range of the sound spectrum was found to be somewhat subdued in relation to the lows and mid-ranges, even with the DuK-15 controls at maximum level, a stepped T-pad attenuator was connected in each pair of leads to the JBL low- and mid-range speakers. Decreasing the l.f. signal by 6 db gave an effective increase of 6 db in the highs, thus giving the desired balance of lows, middles, and highs, yet kept power requirements well within the capacity of the amplifier—even at sound levels far above normal.

Because he is an apartment dweller, Mr. Jacolow thought that he would like to have some means of enjoying his music at hours when normal listening volume would probably upset his good neighbor policy. The choice here was a pair of Beyer stereo earphones, incorporated into the system rather flexibly.

A panel was made up which would perform testing functions and supply receptacles of the proper termination by which the phones could be plugged into the system. Each component in the system leads into the panel by means of a terminal board accessible from below. Thus it is possible to determine average

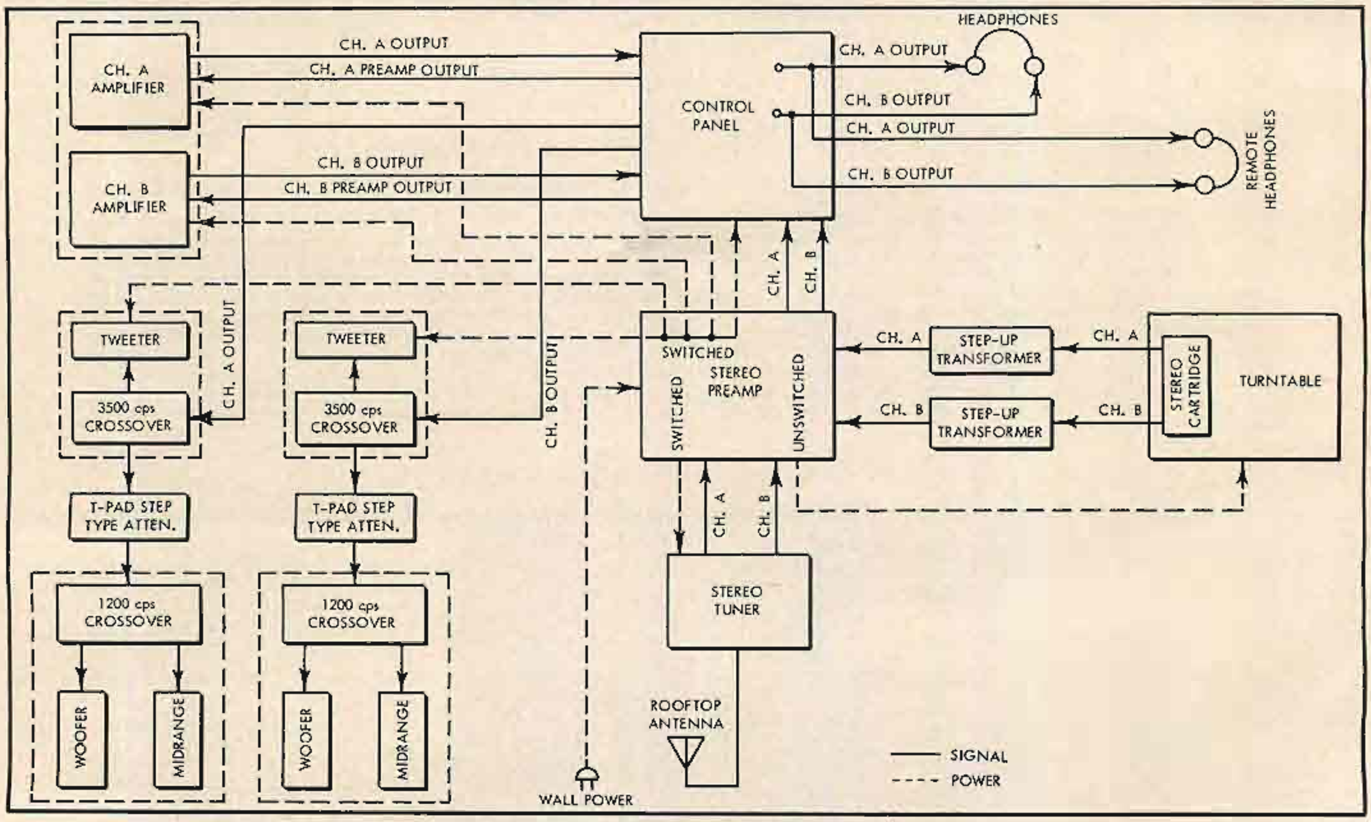

Fig. 1. Block diagram of Jacolow system.

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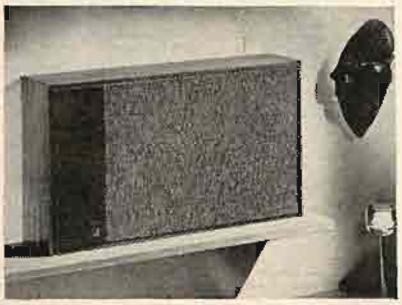

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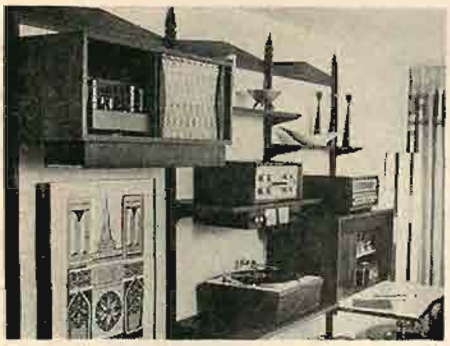

Fig. 2. View of system revealing amplifier. Notice favored position of tuner atop bar cabinet. Another point of interest is the antique-glass doors on the amplifier cabinet which glow at night because of the lighted tubes behind them.

Fig. 3. The Jacolows listen separately—together. Note convenient height of turntable. Also observe panel below the preamp with meters and headphone jacks.

Fig. 4. Receptacle behind sofa is normally hidden by drapes.

power output, separation of any stereo input source, and amplifier and preamplifier malfunction. As all component a.c. lines plug into separate, and hidden, receptacles which, in turn, plug into the preamplifier a.c. receptacles, removal of any component can be accomplished by disconnecting it from the panel and its a.c. receptacle without upsetting much of the carefully hidden wiring.

Two illuminated VU meters are activated by a switch, as are the stereo phones. A side-panel switch may be used to defeat a built-in Bauer circuit when stereo headphone output is desired. The "headphone-speakers-headphone" switch is basically a convenience item. Should a listener put on the headphones with channels reversed, he can correct at the panel rather than reverse the phones or use the preamplifier reversal control.

Transformers were originally built into the panel so that meter sensitivity, sufficient for indications at moderate sound level, might be increased for use with the extremely sufficient JBL's. The transformers were found to introduce distortion and were discarded. The addition of the T-pad attenuators, however, performs a secondary function in that they make possible moderate level readings with the Lansings.

Additional phone lines hidden under the carpeting and terminating at a receptacle behind the sofa permit use of the phones at the room's optimum listen-

(*Continued on page 98*)

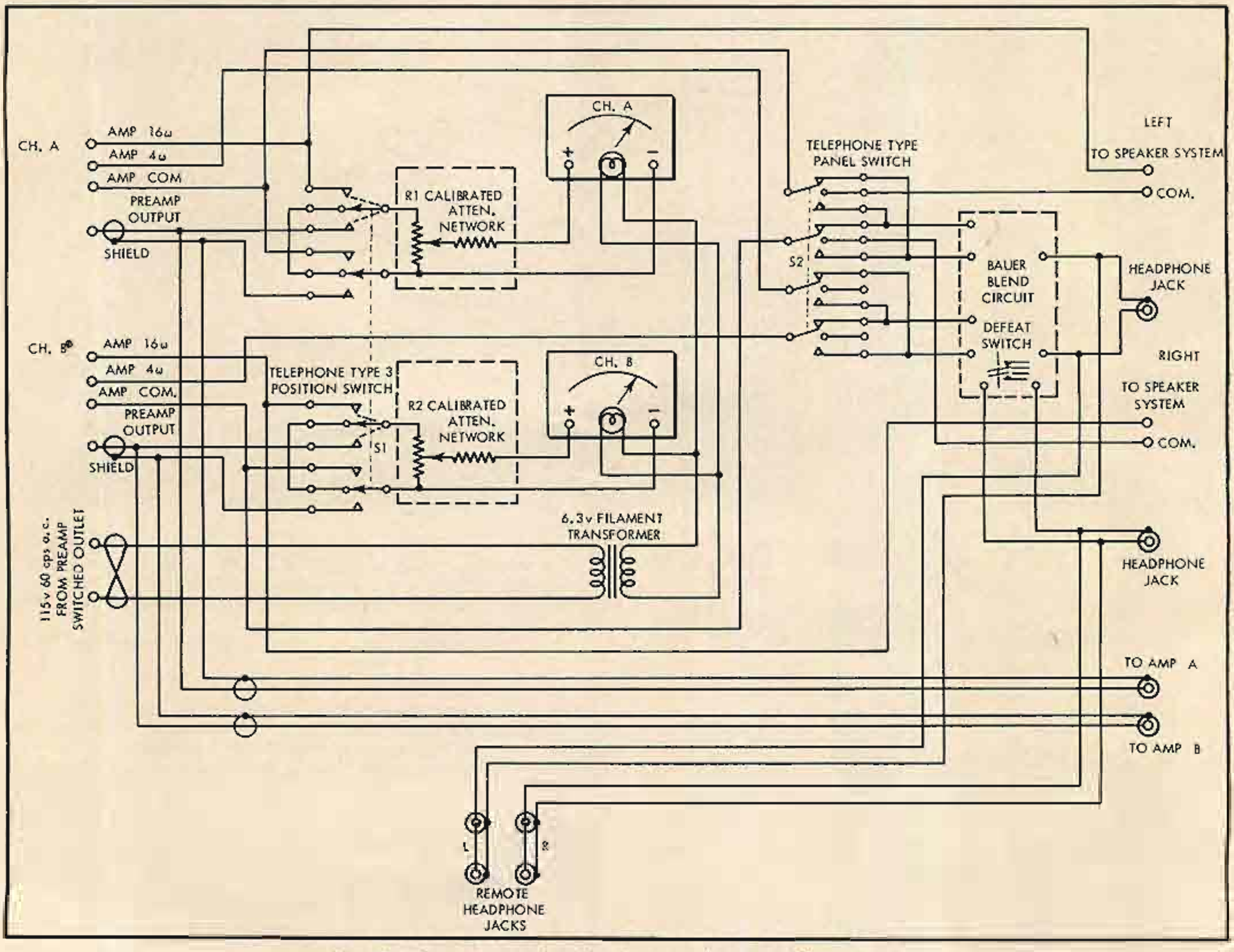

Fig. 5. Schematic of the Jacolow speaker switching panel.

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Transistor Output-Stage Response

GEORGE FLETCHER COOPER

An analysis of the trap inherent in very low-impedance drive of transistor output stages

In the May issue of Audio I attempted to give a survey of all the transistor amplifiers giving a fair amount of power and reasonable quality which is commercially available. Just what is meant by fair power and reasonable quality I left to the manufacturers, in the sense that if they chose 1 per cent distortion rather than 0.5 per cent that was still in the quality class rather than the public address class, for which 5.0 per cent is normal. One more amplifier was seen at the London Audio Fair, but the makers sent me a circuit diagram without any values on it, so it is in cold storage for the moment.

As I say, these were the amplifiers you can buy. This was not good enough for one reader, Mr. W. Barry Clark of Kitchener, Ontario, who has written to point out that I made no mention of the principle of very low-impedance drive of an output stage using standard alloy transistors. The technique, says Mr. Clark quoting a reference to an EIA/IRE meeting, "lies in the use of a simple trifilar transformer to unity-couple a common collector driver to the bases of the two output transistors. Even the most conservative design of this transformer results in one weighing a few ounces and easily hand-made or manufactured. The resulting cut-off frequency is many times the beta cut-off frequency."

I did not mention this circuit because no one is using it, or if they are, they have not told me. It is, however, a rather interesting circuit because to my mind it contains a trap, and when I was tempted by it a couple of years back I decided it would not work. Readers should understand that editors are very nice chaps, which is British for warm and lovely people, and I myself never get married without having an editor along. They do have a rather unfortunate belief, however, that everything will go right in the end. For this reason they like to print articles about circuits that work, which only need inventing once, while those that don't work are swept under the carpet to be invented and reinvented over and over again. This is where engineers waste their time.

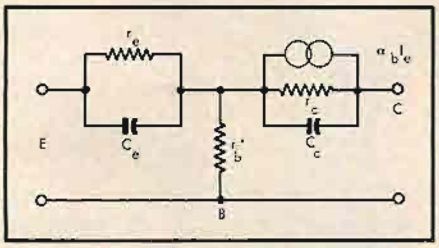

Fig. 1. A transistor equivalent circuit for use in the octaves around cut-off.

We need to hear more about circuits that do not work and, perhaps, all about those that do.

The problem of drive impedance for a transistor output stage is one of the key problems in amplifier design and in fact we must consider it from two aspects, distortion and frequency response. Distortion is said to be least if a low source impedance is used, but I should like to discuss this in some detail at a future time. Immediately we have this matter of frequency response, which has some extremely important implications well beyond the basic question raised by Mr. Clark.

We need to go back to first principles to see what is happening, and first principles mean that we must think in terms of the common-base circuit. We consider a p-n-p transistor with a positive bias applied to the emitter and a negative supply connected to the collector. The main parts of the emitter, base, and collector regions are virtually field-free, with the voltage drops appearing across the barrier layers, the depletion layers.

As you know, when the emitter bias is increased slightly some additional holes are injected into the base at the edge of the depletion layer. Since there is a small field in the base these holes drift towards the collector-base barrier as they diffuse and when they reach the collector-base barrier they are swept out to the collector. The result of all this is that there is a time lag between the appearance of holes at the emitter side of the base and their movement through the collector barrier.

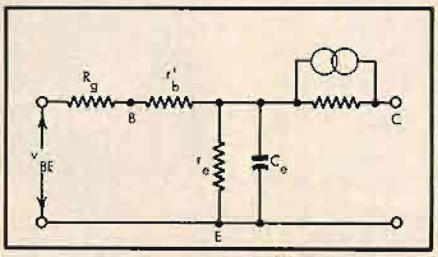

Fig. 2. The input circuit is the vital part in considering a grounded-emitter stage.

A second effect is the charge storage effect. The capacitances across the barrier layers must be charged through the electrode resistances, so that there is the characteristic exponential rise of current when the voltage is given a *small* step. We can draw a first-order equivalent circuit in the form shown in *Fig.* 1.

At low frequencies we can forget the capacitances and we drive in a current, I_b, to the base in order to produce a current, I_e, at the emitter and a current of αI_e at the collector. The gain of the stage $\alpha I_e/(1-\alpha)I_e = \alpha/(1-\alpha)$ we call β. The input impedance is easily seen to be given by the fact that for the input current of $(1-\alpha)I_e$ we get a drop of $(1-\alpha)I_e r'_b$ across r'_b and $I_e r_e$ across r_e, so that

$$R_{in} = [r_e + (1-\alpha)r'_b]/(1-\alpha) = r'_b + r_e/(1-\alpha)$$

I do not propose to go into the analysis in any detail because it can be found in the literature. What we want can be treated rather simply by means of the common-emitter equivalent circuit in *Fig.* 2. This is a general circuit as far as the generator is concerned, for we can make R_g zero and work with a voltage source or make R_g very large, the condition we should have with a current source.

The key to the frequency response is the time-constant of the input capacitance-resistance network. If in the arrangement of *Fig.* 1 we neglect r'_b, and remember that in the grounded-base arrangement we always talk of injecting current at the emitter, we can see that the essential frequency is fixed by C_e and r_e and is the characteristic frequency given by the equation

$$\omega_a C_e r_e = 1$$

At any frequency the effective current gain, in grounded-base, is

$$\alpha = \alpha_o/(1 + j\omega/\omega_a)$$

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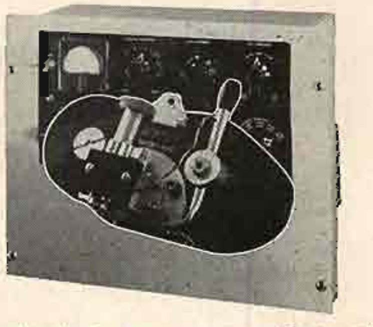

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From this we have, of course,

$$\beta = \mathring{\alpha}/(1-\mathring{\alpha}) \simeq \beta_o/(1+j\omega\beta/\omega_a)$$

which gives us the much lower cut-off frequency in grounded-emitter,

$$\omega\,\beta \simeq \omega_a/\beta$$

What has happened, of course, is that for the same current in the collector the external supply of holes has been reduced by the factor β and the capacitance takes just that much longer to get charged.

We can write the common-emitter time constant in rather a different way. The effective resistance in shunt with the emitter capacitance is r'_b in series with R_g in one arm and $r_e/(1-\alpha_o)$ in parallel with it. This gives us the expression

$$\omega_c = \frac{1}{C}\left[\frac{1-\alpha_o}{r_e} + \frac{1}{r'_b + R_g}\right]$$

It is easy to see that the smaller we make R_g the larger we make ω_c, the cut-off frequency.

This is the case for using a low-impedance base drive to extend the frequency response. If you stop here there is no doubt about its advantages. Let us take the one extra step which reveals the trap into which we shall fall. The input impedance at the base is

$$r'_b + r_e/(1-\alpha)$$

or so we rather hopefully think. But r_e has C_e in parallel, so we must write

$$r'_b + \beta r_e/(1+j\omega r_e C_e)$$

When the frequency is high, $\omega r_e C_e$ becomes important and the input impedance begins to fall. We find, in fact, that for the front edge of a square wave input we see an input impedance of only r'_b. In consequence the base current for a square voltage step at the base has the form shown in *Fig.* 3, in which the peak value reached is V_{BE}/r_b'.

There is another way of seeing the effect, the way I used in meditating about Mr. Clark's letter before I got down to doing any calculations. It involves drawing the transistor pictorially in its circuit in the form shown in *Fig.* 4. When a square wave-front first appears across the transformer secondary the collector barrier layer knows nothing about what is going on. It must wait for holes to diffuse through the base layer. The collector loop is therefore not part of the circuit at all and we are just concerned with the base-emitter diode. This is pretty much the condition we have with a grounded-base state and we shall call for full grounded-base input current until the the collector current starts to rise. By this reasoning we can construct the current diagrams of *Fig.* 5, which show the emitter current rising quite quickly, the collector current rising at an appreciably slower rate and the hump in the base current caused by the difference between them.

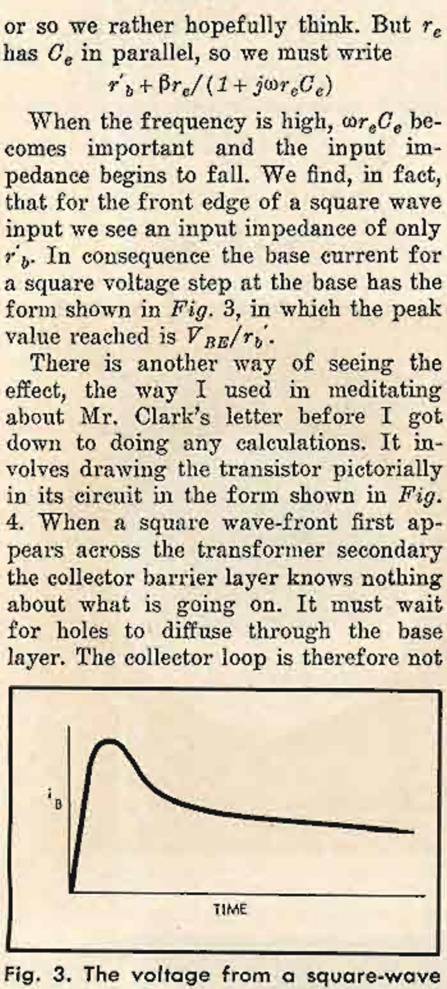

Fig. 3. The voltage from a square-wave input must change the emitter capacitance.

Now we come to the pay-off. We may want, in a typical power amplifier, a collector current of 2–5 amps and we may have a beta of 20–50, figures chosen to make the typical base drive reach 100 ma peak. The driver stage for a class-B push-pull circuit will be in class-A and we might set it to run at 150 ma, peaking up to 250 ma and down to 50ma. What, we may ask, could be more attractive? We need only have, say, 6 volts across the transistor, giving a dissipation of about 1 watt. We could even reduce this to 3 volts, giving only half a watt and making it still easier to find a cheap high-frequency transistor. However, if we want the 2–5 amps collector current in a hurry we have to supply just about this current into the base-emitter diode of the output stage, and the small driver transistor cannot do this. We are not very likely to provide a class-A driver running at 5–6 amps: we must limit our requirements.

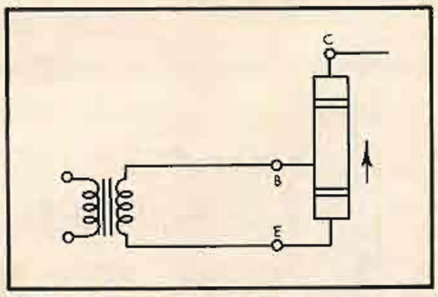

Fig. 4. Until the carriers from the base-emitter junction reach the collector-base junction, the collector circuit is virtually disconnected and need not be drawn.

It is pretty easy to see what the limitations are without doing any mathematics. Up to a frequency equal to the beta cut-off frequency we can get full power out. At the beta cut-off the available power, for a limited base-current drive, will in fact be one-half of the maximum because the power response will be 3 db down. The asymptotic characteristic falls 6 db per octave above the beta cut-off and if, for example, we claim to have raised the maximum working frequency by a factor of 4 times in a 32-watt amplifier we can only take 2 watts out at this new limiting frequency.

Does this matter? Do we ever need 20 watts of the upper registers of the piccolo? Expressed in that way the answer is self-evident and again, I think, false.

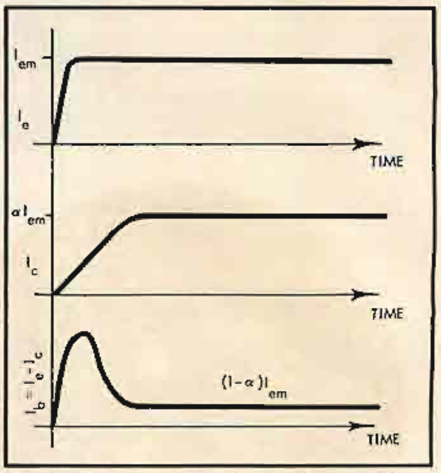

Fig. 5. Since I_e grows faster than I_c, there is a bass current peak.

Most of the current swing is used up by the double bass and there is no room left for excessive demands of the kind we have been considering.

Anyway, we could get ourselves into this situation by quite a different route. All we need to do is construct any amplifier with a wide-band front end and a band-limited output stage and apply negative feedback round the whole system. The small input step will be amplified by the factor μ until the message gets through to the collectors to send back a term μβ. I wrote an article called Serial Feedback which is somewhere around the editorial offices about this, so I do not need to go into any detail here. The point is that we can get just the same band-broadening effect at just the same price by putting feedback right around the amplifier. The transformer turns out to be a rather wasteful phase-splitter.

I quite appreciate the advantages of using a 1:1:1 transformer, with its very tight coupling, but it should not be overlooked that this is not the most economic way of using the common-collector driver. We shall have far too much voltage and far too little current available and we shall be wise, if we want to use a transformer, to face the problem of letting it transform, of providing a more satisfactory load for the common collector stage. The input impedance of our power stage is likely to be in the region of one ohm to ten ohms and we could easily accept a load impedance of 100 ohms under typical supply conditions so that a current step-up of 4–5 times is easily achieved. This would be of real value during the grounded-base mode period in the output stage.

There is one interesting possibility which I shall try to explore in another article, and that is the use of a split-load stage. The trifilar winding gives us a good transformer response but the wrong ratio of voltage to current. A full loading in a common-collector stage

(*Continued on page 99*)

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RECORD REVUE

Edward Tatnall Canby *

Richard Strauss: Till Eulenspiegel, Dance of the Seven Veils ("Salome"), Don Juan. Philharmonic Orch., Klemperer.
Angel S35737 stereo

The great and definitive Klemperer series of recordings continues to roll forth—like the big Toscaninis when that Maestro was still in high-power production, like Bruno Walter recordings for Columbia over the last five or six years. It is safe to say that Klemperer won't do any better than his present output. This, so to speak, is "it." Now, after hefting the big German works, notably Beethoven, the tall, fierce, elderly conductor is hitting the sidelines with such items as these by Strauss.

Odd—though Klemperer is, of course, of a younger generation than Strauss himself, somehow these interpretations have a somewhat old-fashioned ring to them, of a pre-Straussian time. Especially in the famous dance from "Salome" and the tone poem "Don Juan." What seems to be different, or missing, to my ear, is the electric tension that is built into these scores and many another by Strauss. Here, we have a Wagnerian richness, a high amperage of musical communication. But at relatively low voltage.

It could be also the British players, who are definitely more easy-going than ours in the big U.S. orchestras. It could be Klemperer himself. In any case, Salomé dances lushly but without that almost hysterical nuance of background horror, that crackling "brush discharge" sound that, say, a Fritz Reiner can evoke with chilling effectiveness. In "Don Juan" what is lacking is the similar contrast between extreme ecstasy and sudden, dissillusioning let-down. Again, Reiner gets it over. Klemperer and his British men don't.

Segovia. (Castelnuovo-Tedesco, Frescobaldi, Weiss, Dolor, Debussy, Sor.) Andrés Segovia, guitar.
Decca DL 710054 stereo

I wonder whether the old master of the classical guitar isn't becoming Decca's mainstay. He keeps on issuing disc after disc and, the country over, the guitar keeps on getting popularer and popularer—both to play and to be listened to, in all its many languages including Segovia's, which is unique. Everybody imitates him but not a one can match his peculiarly old-fashioned, lush, sunny, old-Romantic guitar style.

The Segovia output is always graced with two main sorts of staple fare. First, a few of the thousands of "modern" pieces written for and dedicated to Segovia. Second, a brace of Segovia-arranged classics, from the harpsichord or the piano. Lately, both types have been becoming more daring, if one may speak relatively.

Here, for instance, is a whole little suite of "modern" guitar music by Castelnuovo-Tedesco, "Platero and I." Platero is a Spanish donkey, a bit like the famous one that carried the good Sancho along with Don Quixote. Nice, inoffensive, fluent guitar music, the sort that would sound trifling via any other medium but somehow is absolutely right for the guitar. Very pleasant. Then several transcribed works of Frescobaldi, the "Maid with the Flaxen Hair" of Debussy (always one familiar item like that on each Segovia disc), a lute piece by a Bach-period German named Weiss, and a Basque folk piece, from the piano, by one Jose Zulaica y Arregui—and, inevitably, the usual items by that indefatigable Paganini of the guitar, Fernando Sor. Nobody ever leaves *him* out.

If you like guitar background music, here's another half hour or so for your collection. If you *play* classical guitar, you'll have to own this set and you'll study it like crazy, and spend years trying to play the same way.

Please, Decca, better surfaces and less noise in the lead-out grooves.

Old Grads

Chopin: Piano Concerto No. 1, Opus 11. Schumann: Overture, Scherzo and Finale for Orch., Opus 52. Rosina Lhevinne; Members of the Alumni of the Nat. Orchestral Ass'n., Barnett.
Vanguard VSD 2111 stereo

Vanguard has grabbed some good things here in a fine combination.

First—the "dean" of lady pianists in America, over eighty but as keenly accurate and musical as only a sublimely endowed piano teacher for a half-century can be when she finally gets back to concertizing on her own, instead of teaching other pianists. Then, second, a unique and splendid collection of American musicians, all graduates of a young people's training orchestra in New York that has fed players to the world's orchestras for thirty years and more under Leon Barzin, now retired in favor of the present John Barnett. Mr. Barnett has picked up extraordinarily fine notices for the music played by his current crop of youngsters-in-training. Here are the old grads, and they are good, let me tell you. So is Barnett. Such lively, fresh, romantic playing! It has the enthusiasm of an old grads' reunion and the precision of a group of highly experienced experts.

And finally, there is an extra, the almost unknown early orchestral work of Schumann, in three interconnceted sections, one of those freaks that for some reason never gets played though it sings along with the best. I enjoyed every moment of it.

I like, too, the sound of Vanguard's recording, warm, mellow, somewhat distant but not the less full and round. It has one curious aspect, though. A very heavy, prominent bass. Is it a matter of equalization—an upcurve in the "curve?" Or is it merely an unusually good recording of genuine, undepleted, uncencored bass? Or again, is it maybe a question of miking—too much cello and double bass sound? I'm inclined offhand to favor the second and third hypotheses, taken together. I do seem to hear the cellos and basses rather decidedly. People with big-bass speakers will be happy, anyhow, and the table-model people will never know the difference.

Pronouncing the Classics (klas'iks). Narr. by T. A. McEwen and John Coveney.
Record Source International
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Names, names, names. Compositions, artists, composers, by the hundred. Each one is pronounced, slow'ly and care'ful'ly. As a key for the booklet that gives spelling and pronunciation aid, there is a number assigned to each name, duly read out loud (by producer Coveney—I know his voice) just before the name is pronounced. There are, to be precise, just 200 names, from Adolphe Charles Adam (ah dolf' sharl ah dahm') to Guiseppe Zampiere (who must be pronounced joo sep' pee zahm' pyair ee). The names cover a fairly standard wide-range musical repertory—even including Palestrina and Monteverdi (but not Lassus) . . . one could have fun picking faults with the contents, but why bother. Lots of compositions are named too, after their composers.

How good is the pronunciation? Standard American-based foreign accent, not quite like a native but OK for all radio purposes. I happened to have a Spaniard next to me as I played over a few of the names. He winced mildly when the Spanish ones came along. I wouldn't know the difference, nor would you, most likely.

Flute Concertos of Eighteenth Century Paris. (Boismortier: Three Concertos for Five Flutes; Corrette: Three Concertos Comiques, Op. 8.) Jean-Pierre Rampal, Samuel Baron, Harold Bennett, Lois Schaefer, Paula Robison, flutes; Robert Veyron-Lacroix, hps., David Soyer, cello.
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Well, for goodness sake. It took me several minutes of dismayed listening before I noticed that I was playing this *45-rpm* stereo record at the usual speed, 33⅓ rpm. Such a soggy sound! This label seems to be a newborn relative of the recent and equally-speeded label called, somewhat cryptically, "Quarante Cinq." Fine for those who happen to know that it means "forty five" in French. When you play these discs at 45 you'll get some pretty fancy quality. The technical statistics can easily show that at 45 one can cover most of the musical time-span found on 33⅓-rpm LP's today and with better over-all quality. Well, so they tell me anyhow.

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(*Continued on page 102*)

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Extending the Usefulness of the Schober Autotuner

WINTHROP S. PIKE*

A slight change in operating procedure makes it possible to use this instrument for A-435 instruments. And a slight change in circuitry and wiring decrease the hum level appreciably to permit use of lower-level inputs from microphone.

Recently a most elegant and inexpensive device, the Schober Autotuner, has appeared on the market. A boon to the electronic-organ owner who wishes to tune his own instrument, it provides a simple and accurate solution to the age-old problem of "setting the temperature" or, as some tuners call it, "laying the bearings." The inventor's original paper[1] should be consulted by readers interested in the theory of operation of the Autotuner. Briefly, it is a stroboscopic device which provides an accurate visual means of rapidly tuning all the notes of one octave of an organ or piano to the required frequencies of the equal-tempered scale. To use it, the frequency of a specified note is first tuned by direct measurement with the Autotuner. Succeeding notes of one complete octave are then adjusted in pairs, the Autotuner measuring the beat frequency between them.

Without an Autotuner this process, which has been referred to by one organ designer as the *"pons asinorum* of the novice tuner,"[2] is cumbersome and time consuming. Even experienced tuners rarely accomplish it in less than half an hour using the classical method of tuning in fourth and fifths. By comparison, tuning the remainder of the organ in octaves to the first octave is dead easy. No "musical ear" is required—merely the ability to hear beats. One literally needn't be able to tell "Pop Goes the King" from "God Save the Weasel" to do it.

The Autotuner was designed especially for electronic organs, for which it works extremely well. It is the purpose of this paper to describe a modification of the device which improves its performance on pipe organs and pianos. An extension of the normal operating mode of the Autotuner will also be described which permits using it at the non-standard A-435 pitch sometimes encountered in older instruments.

In using the Autotuner on an electronic organ, one normally connects it directly into the organ's tone-generating system. When so connected, there is always plenty of signal available at the Autotuner input terminals, the signal-to-noise ratio is good, and excellent stroboscopic patterns are obtained. Equally important, the individual notes of each note pair presented to the Autotuner will be of equal amplitude. This condition automatically ensures that the maximum possible amplitude of beat-frequency signal is available to flash the neon bulbs which illuminate the stroboscopic disk of the Autotuner.

The situation is not as fortunate when tuning a pipe organ or piano. In this case the Autotuner microphone must be used to convert the sounds of the organ to the electrical signals required by the Autotuner. The signal-to-noise ratio at the input of the latter will inevitably be poorer due to room noises, the position of the microphone with respect to the pipes, and so on. Furthermore, because of reflections from the room walls and their attendant multipath cancellation effects, the individual notes of each note pair presented to the Autotuner may be of quite different intensities at the microphone position. The resulting beat frequencies produced within the Autotuner

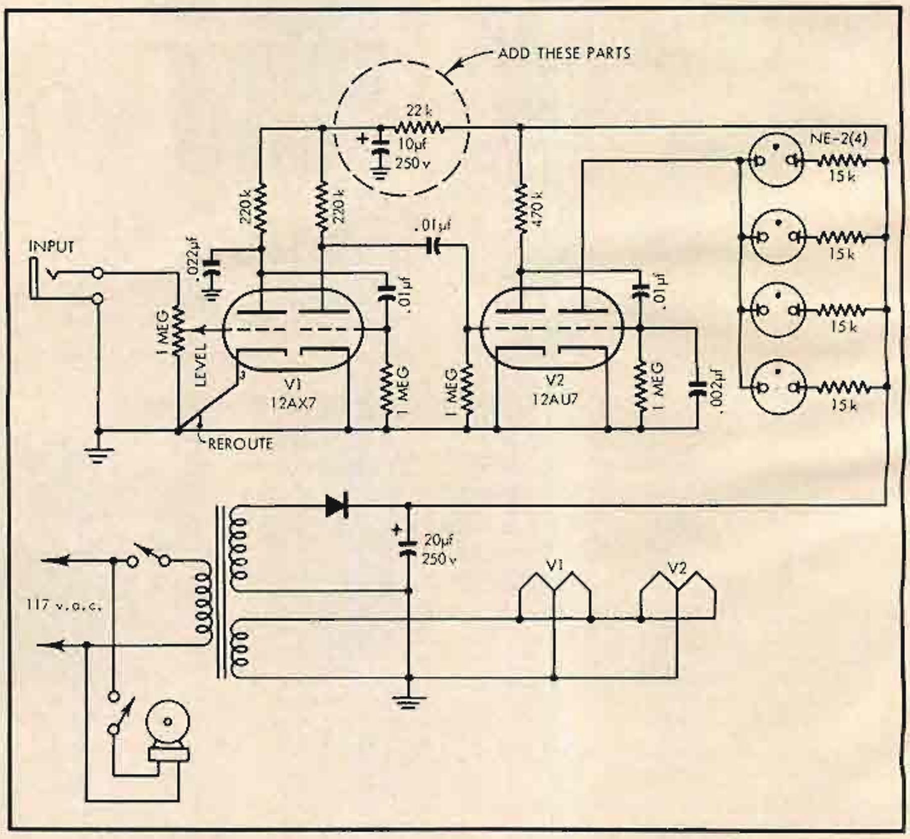

Fig. 1. Schematic of the Schober Autotuner showing the two modifications described in the text.

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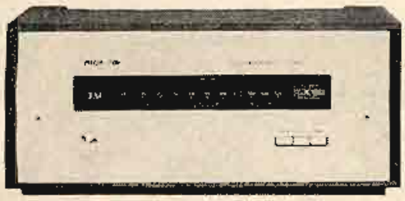
* *165 Hickory Court, Princeton, N. J.*

[1] Richard H. Dorf, "Strobo instrument tunes organs." *Radio Electronics*, February, 1961, p. 42.

[2] Noel A. Bonavia-Hunt, *"The Modern British Organ,"* p. 147, New and Revised Edition, A. Weekes & Son, London.



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are of lower amplitude, thus reducing the contrast of the stroboscopic patterns. These two phenomena make the desired patterns more difficult to distinguish from the faint pattern produced by the residual power line hum in the Autotuner itself. It is therefore worthwhile to reduce this hum. Fortunately, it may be reduced easily and cheaply.

Reduction of Hum

Figure 1 shows the Autotuner circuit. By adding one resistor and one capacitor and moving a ground lead, a tenfold reduction of the residual hum may be obtained. The added components are indicated on the diagram. They will be seen to provide increased filtering of the plate supply of the first two amplifier stages. The ground-lead modification, though shown, is not readily apparent from the schematic. What appears to be involved is a common path for the cathode current of the first amplifier tube and the 60-cps heater current of the same tube. The ground modification to be described breaks this path.

To carry out the modification, locate the 220-k load resistors of the 12AX7. Carefully unsolder the end (of each) which goes to the plate-supply bus, pulling the leads loose from the printed wiring board. Do not unsolder the other end of either resistor. Insert one end of a 22-k ½-watt resistor in one of the holes in the printed wiring board from which a 220-k resistor was just removed, and carefully solder it in place. Solder the other lead of the 22-k resistor to the two loose leads of the 220-k resistors. Now solder a 10-μf, 250-volt capacitor from this point to ground, observing polarity. A convenient ground point is pin 8 of the 12AX7. If a "firecracker" type capacitor is used, spaghetti is placed over its leads, and care taken in lead dress, it will be found that there is adequate space to tuck this capacitor in below and to the right of the Autotuner motor.

Next, remove the short bare wire connecting pin 3 (cathode) of the 12AX7 to the printed wiring board and discard it. Using a piece of insulated wire, connect pin 3 instead directly to the grounded lug of the 1-megohm input-level control. This completes the modification. On the particular Autotuner available to the author, these changes reduced the hum at the amplifier output (pin 1 of the 12AU7) from slightly over 40 volts peak-to-peak to just under 5 volts, the measurements being made with an oscilloscope.

It will now be found that in the absence of an input signal the residual stroboscopic pattern formerly produced by hum has all but vanished. When the desired tuning pattern is low in contrast, because of one of the factors previously mentioned, it will now be found easier to see as it is no longer obscured by the hum pattern.

TABLE I

A-435 TUNING PROCEDURE

Note	Pitch Desired	Procedure	Pitch Obtained	Error
G	387.54	Tune to stop pattern, then flat pipe till pattern drifts at rate of 60 segments/minute.	388.00	+.46
G♯	410.59	Tune to stop G♯ pattern.	411.00	+.41
A	435.00	Tune to make G♯ and A patterns rotate at equal speeds in opposite directions.	435.00	0
A♯	460.87	Tune to stop A♯ pattern.	461.00	+.13
B	488.27	Tune to make A♯ and B patterns rotate at equal speeds in opposite directions.	488.00	−.27
C	517.31	Tune to stop C pattern.	517.00	−.31
C♯	548.07	Tune to stop C♯ pattern.	548.00	−.07
D	580.66	Tune to stop D pattern.	581.00	+.34
D♯	615.18	Tune to make D and D♯ patterns rotate at equal speeds in opposite directions.	615.00	−.18
E	651.76	Tune to stop E pattern.	652.00	+.24
F	690.52	Tune to stop F pattern.	691.00	+.48
F♯	731.58	Tune to make F and F♯ patterns rotate at equal speeds in opposite directions.	731.50	−.08

Tuning to A-435

The author owns (or perhaps is owned by) an antediluvian pipe organ which is tuned to the older A-435 pitch standard. Re-tuning the instrument to the present standard pitch (A-440) would entail physically shortening many of the flue pipes—with a hacksaw—as well as the even touchier task of re-regulating the reed stops. Could the Autotuner be used in this case? Reference to tables of note frequencies for equal-tempered scales[3] based on A-435 and A-440, and a little calculation of beat frequencies, made it appear that the errors would be intolerably large. This was confirmed by a trial tuning session. If one attempts to tune an organ at A-435 using the normal Autotuner procedure, intolerably large departures from equal-temperament result. It turns out, however, that a modified procedure can be used which works quite adequately. This procedure is summarized in Table I, showing the pitch desired for each note, the tuning procedure, the actual pitch obtained, and the error. A positive sign preceding the error indicates that the pipe is sharp; a negative sign indicates that it is flat.

In using the table, proceed as follows: First, draw an 8-foot stop on the division of the organ on which the bearings are to be laid. Using an 8-foot stop is a departure from the procedure which a professional tuner would use but it is necessary here because the first step is to tune low G (96.88 cps) by means of the outer ring of the Autotuner stroboscopic disc. This frequency does not occur within the range of 4-foot stop. If possible, choose a stop such as a Principal which has some harmonic development. It will make it easier to hear beats later on.

Tune the low G (the bottom one on the organ keyboard) to stop the rotation of the pattern on outer (G) ring of the Autotuner disc. Now flat the pipe slightly (by lengthening it) until the G pattern is drifting past the window at a rate of one segment per second, or 60 segments per minute. Use a watch or clock with a sweep second hand to determine this and count segments for a full minute. This process sets the frequency of the low G at exactly 97 cps, or 0.12 cps sharp. The error is not noticeable.

Now draw (turn on) the 4-foot stop normally used for tuning. The 4-foot Principal is customary. Leave on the previously drawn 8-foot stop. Sound the low G and tune the 4-foot stop's low-G pipe to the previously tuned G of the 8-foot stop. Do this by ear, tuning the 4-foot G pipe to eliminate the beat between it and the previously tuned pipe. On normal Principal pipes the beat will be easy to hear. Last, put off the 8-foot stop and tune the G below middle C of the 4-foot stop to its own low G by holding both notes (an octave apart) together and tuning the upper one to zero beat with lower. This procedure tunes the G below middle C of the 4-foot stop to 388 cps. One is now ready to resume use of the Autotuner.

Hold the G and G# below middle C together and tune the G# to make the G# Autotuner pattern stand still. If

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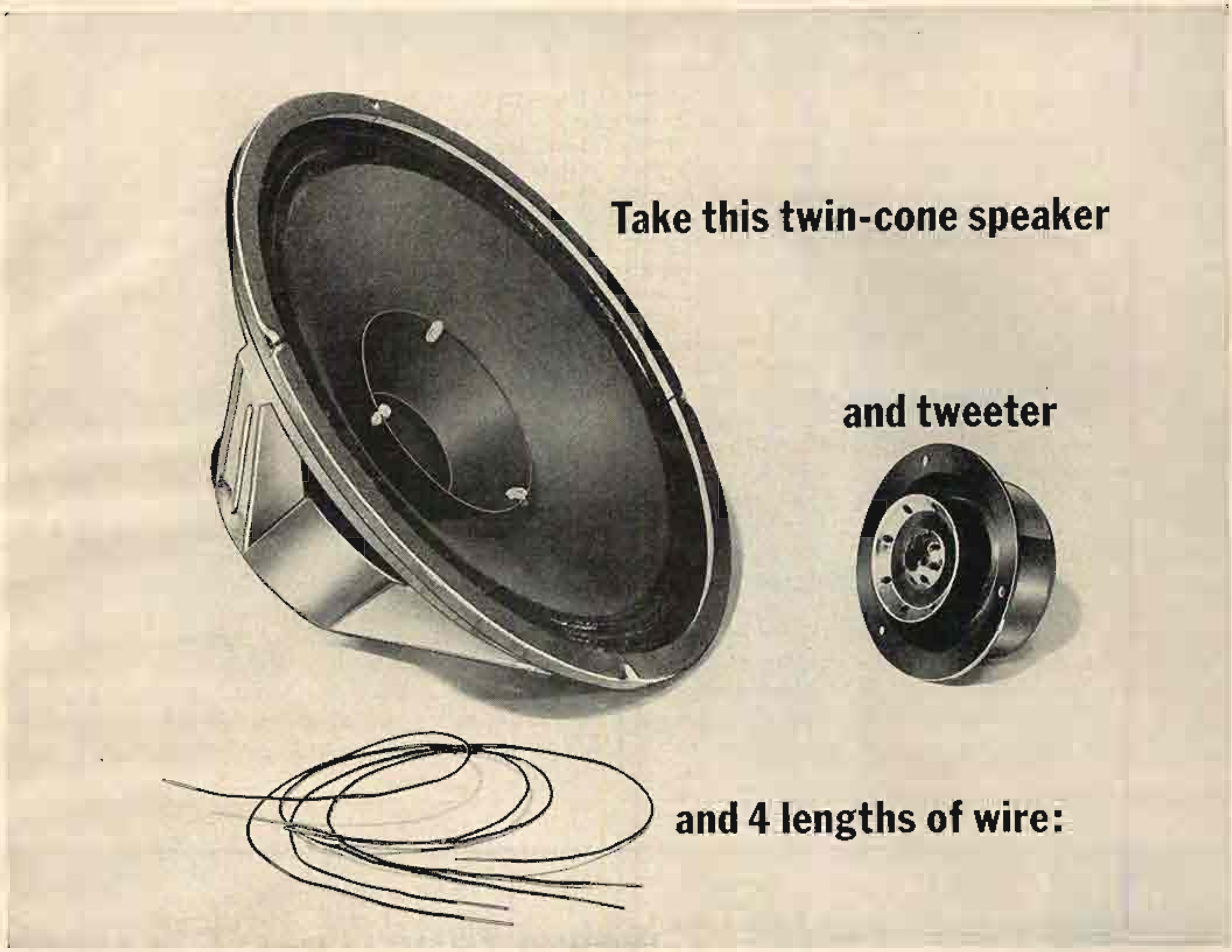
[3] *Handbook of Chemistry and Physics*, Twenty-Fifth Edition, p. 1825, Chemical Rubber Publishing Co., Cleveland, Ohio.



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difficulty is experienced in getting a pattern of good contrast on this or any of the remaining steps, try changing the microphone position or adjusting the "Level" control. One or both will always make an improvement. Ideally, the microphone should be equidistant from the two pipes sounding but multipath cancellation effects may easily make this placement vary from excellent to useless as successive different combinations of pipes are used.

When the G♯ is in tune, hold G♯ and the A above it. Do not attempt to tune the A pipe to make the normal A pattern stand still. Instead, tune the A pipe to make the A and G♯ patterns rotate in opposite directions at equal speeds. This sounds difficult but will be found easy in practice. When this condition is satisfied, the A will be tuned to exactly 435 cps. Continue on with the remaining notes as shown in the table. Observe that on three other notes, B, D♯ and F♯, one substitutes the equal speed opposite rotation technique for the normal procedure. The last note tuned will be F♯ above middle C.

The octave between G below middle C and F♯ above is now in tune. The remainder of the organ may be tuned to it. As a practical matter, the remainder of the 4-foot Principal would first be tuned in octaves, taking extra care to do a good job. The rest of the stops in the organ (with the exception of the out-of-tune ranks of any Celeste stops) are then tuned note for note to it. This follows normal pipe organ procedure.

One important thing to remember about pipe organs is that flue pipes are temperature sensitive, rising in pitch with a rise in temperature and falling as the temperature is lowered. The effect is not due to thermal expansion or contraction of the pipe walls, as might be expected, but is caused by the change in the velocity of propagation of sound in air. The latter is very strongly temperature dependent. If, for example, an organ is tuned to A-440 on a day when the temperature in the organ chamber in 70° F., it will be found that if the chamber temperature is reduced to 60° F.—typical on winter week days in thrifty parishes—the organ will be approximately 1 per cent lower in pitch, or at about A-435. This applies, however, only to the flue pipes. Reed pipes, such as the Oboe, Trumpet, Krummhorn, and so on, are less strongly affected by temperature as their pitch is determined in part by the physical length of their brass reeds.

CAUTION!

Lastly, a word of caution to the novice tuner. Pipe organs are delicate affairs despite their robust sound and massive appearance. Organ pipes shorter than about 4 inches in length are usually made of an extremely soft lead-tin alloy called "spotted metal." One's fingers alone will suffice to bend this material and after a few bends, it will fatigue through and break. The interior of someone else's expensive pipe organ is no place for the uninitiate. A careless move, a trouser cuff which catches on some hapless little pipe or an experimental prod at some interesting looking gadget can all wreak utter havoc and give some most unpleasant surprises to the unsuspecting organist arriving at the last possible moment before the next Sunday service. If you own your own organ, well and good. Tune away to your heart's content—and your spouse's predictable annoyance. If the organ isn't yours, be careful. Æ

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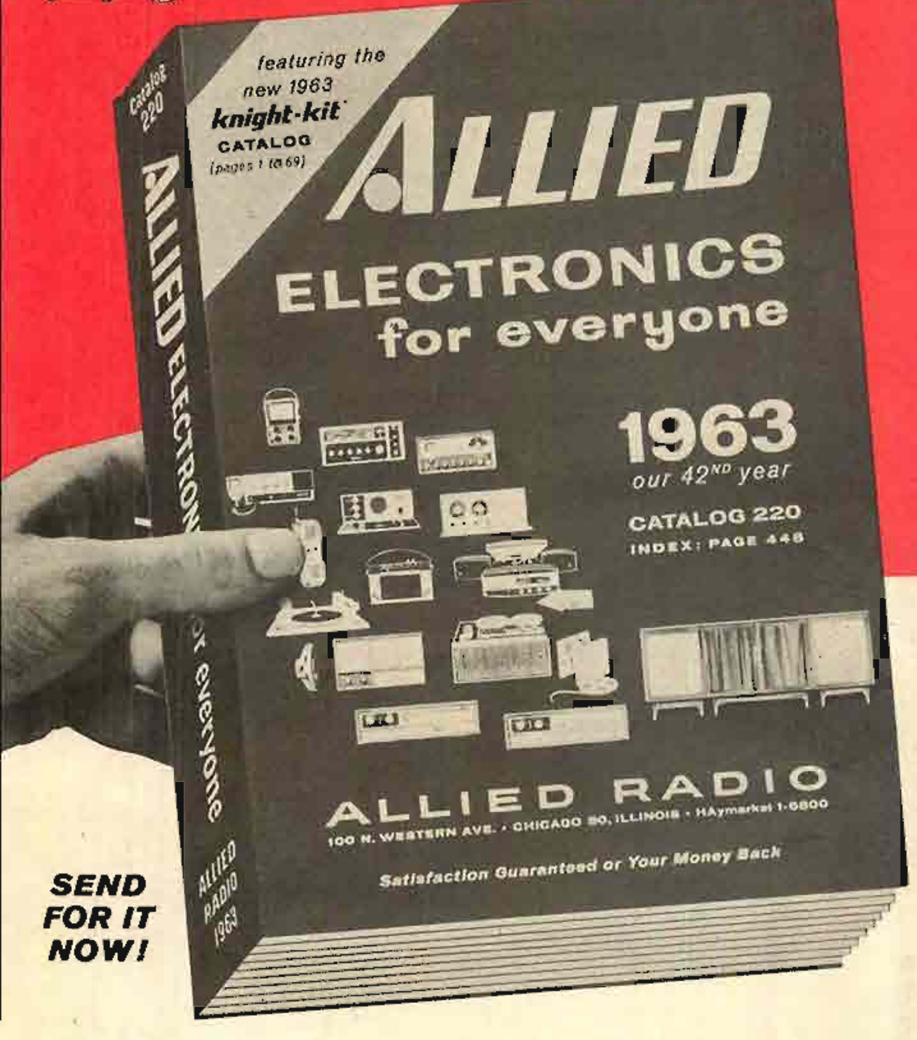

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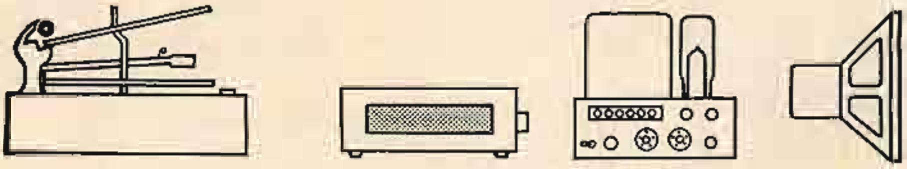
EQUIPMENT



PROFILE

HARMAN-KARDON CITATION A

Nearly three years ago we were privileged to attend the first press showing of the original Citations—I and II—and our comment (which has often been quoted in advertisements with our permission) was that one "listened *through* the amplifier back to the original performance." Of course one always listens through the amplifier. What we meant was that one listened *through*—that is, beyond—the reproducing equipment to the original. Of course one listens through an amplifier except at a live performance. Next time we shall try to be more precise so that omission of italics will not emasculate our meaning.

A month ago we were privileged to hear the new Citation A—a fully transistorized preamp-control center. We are afraid we disappointed the H-K personnel by not enthusing adequately. But, having "lived with" Citation I and being fully appreciative of its listening quality, we felt that the differences were sufficiently subtle to dampen uncontrolled enthusiasm. After all, how much better can something new really be than any top-quality preamplifier on the market today? Practically any high-grade preamp in the high fidelity field today is superior to the equipment used in the average broadcast station. And if we are willing to classify a piece of equipment as being in the 95-per-cent bracket, can there be an *outstanding* improvement over it? Can anyone discern an amazing difference between a 95-per-cent-perfect device and a better one? Maybe in this day of inflation the maximum should be 200 per cent, or possibly 1.000 per cent as in baseball.

The trouble is, we *could* discern a difference. Not world-shattering, perhaps, but still a difference. One notices a degree of transparency (a term commonly used in comparing the sound from a true classical pipe organ as related to that of a "romantic" organ) not often heard. One hears *FURTHER* through the amplifier. Enough of that—let use proceed with the description of Citation A.

Transistorization

The fact that the Citation A is entirely transistorized is not in itself important—we would be perfectly content if improved performance could be obtained by using burnt-out fluorescent starters. The fact that transistors are used is not necessarily enough to compensate for the higher cost. The saving in power consumption is not important; the elimination of heat is not Earth-shaking. What *does* count is that it is possible to attain the improved performance and still reap the benefits named—bonuses in fact.

Because of the lower circuit impedance, a wider response band can be passed with transistors, thus giving noticeably better transient response. The specifications are little short of fantastic—frequency response within ¼ db from 1 cps to 1,000,000 cps, for example. Harmonic distortion is claimed to be unmeasurable at 2 volts output, and IM less than .05 per cent. Noise is 70 db below rated output at 5 mv input reference on phono, and 85 db below rated output from high-level inputs. These specifications indicate a very high level of performance.

The system philosophy of the Citation A is thoroughly professional—that is, it follows broadcast or recording studio practice throughout. All frequency-correcting circuits are passive, and the gain elements are fixed and completely stable. Thus the change in gain of a circuit which in usual amplifiers combines amplification with equalization cannot in the Citation A possibly affect equalization—it can only affect the over-all gain. All amplification in the circuit is provided in the form of separate modules having a gain of 33 db and employing 34 db of over-all feedback. Each of these modules has three or four transistors, and each is on a separate printed-circuit panel which is carried in its own channel within an enclosure at the rear of the unit as shown in *Fig.* 2. Any of these modules may be lifted out of its channel for inspection or measurement without disconnecting a single lead, and the unit can remain in full operation with the module out of place. Thus the individual controls on the front panel are simple passive networks or switches, with all tone control elements completely out of the circuit in the "flat" position.

Physical Arrangement

Since the amplifier modules are all contained in the enclosure at the rear and all controls are located on the front panel, about all that remains is the interconnecting between them. The power supply occupies a portion of the module-containing chassis, with the voltage-regulating circuitry and the rectifier diodes below the chassis. A time-delay circuit is incorporated which withholds application of voltage to the amplifier modules until the power supply has reached full regulation—about 20 seconds.

The panel, which resembles the Citation III in appearance rather more than the original Citation I, is fitted with three large knobs, four smaller ones, four which are still smaller, two smaller yet, and four tiny ones which are essentially knurled shafts. The large knobs control loudness, mode, and function; the next four are individual stepped bass and treble controls, two for each channel. Blend, balance, turnover, and rolloff occupy the next set, while the smaller pair are power switches—one for the entire system and the other for the basic amplifier alone.

The four knurled shafts are panel-variable tape equalization controls, two for each channel. When the turnover switch is in the TAPE ADJ position, these controls are in the circuit for adjustment of tape load and turnover to the exact characteristic desired. Four push-button switches provide for stereo-reverse, rumble filter, contour, and tape monitor. And finally, a stereo headphone jack is located on the front panel. This points up the reason for the separate basic amplifier power switch—you can turn on the power amplifier *from the panel* when listening to headphones.

Performance

More recently we have had a chance to "live with" the Citation under more familiar conditions. It is always difficult to try to judge any equipment in unfamiliar surroundings—loudspeakers which are unknown to us, a different room, and (probably more important) musical selections which we do not know well. And in any comparative listening, one should be able to make instantaneous changes from one condition to another. Perhaps the most important axiom about such tests is that only one thing should be changed at a time.

Thus in our own listening room, with loudspeakers, acoustic environment, phono equipment, power amplifier, and tuner the same for both the "A" and the "B" of an AB test, we were able for the first time to make direct comparisons between the new Citation A and the "old" Citation I. Under these conditions, the previously-thought-subtle differences were much more pronounced—in spite of the recognized quality of the Citation I. Bass appeared to be

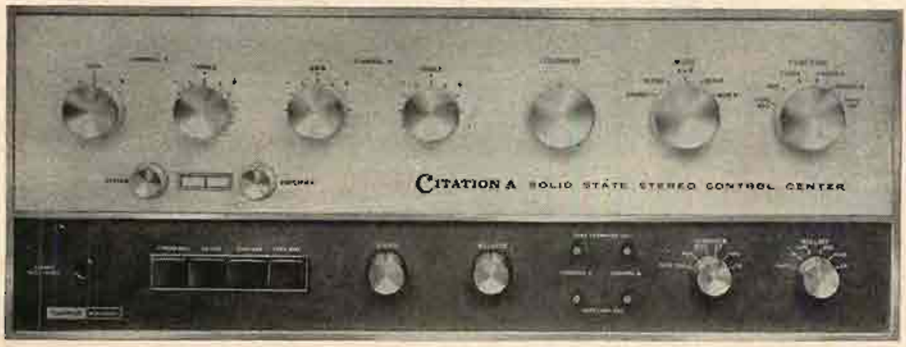


Fig. 1. Panel view of the new Harman-Kardon Citation A transistorized preamplifier.

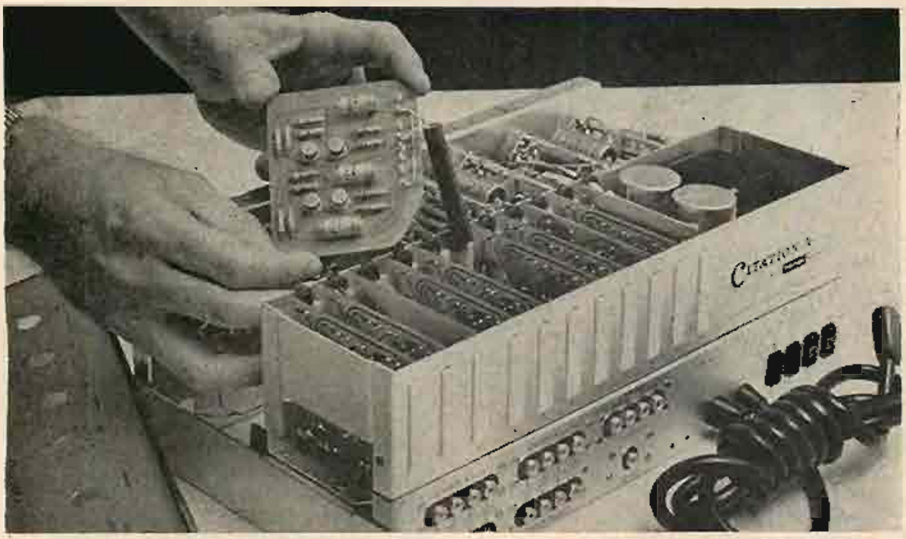


Fig. 2. View of the Citation A showing the housing for the eleven three-transistor modules, one of which is shown removed from the nylon "tracks" into which it fits.

"tighter," and the high end was smooth and crisp, with a differentiation between instruments that had not been noticed before. Not only was this observable on phono, with familiar records, but also with both mono and stereo FM radio programs.

Comparisons were also made from tape, both with and without the built-in amplifier of the tape recorder. The reason for this was to determine how well the adjustable feature of the Citation A functioned. Briefly, the top end can be trimmed by varying the loading across the tape head, which provides a small change in ouput. The turnover control makes it possible to adjust the turnover to exactly the frequency required for the particular head. The controls can be set to accommodate 7½ or 3¾ ips, but still more important it makes it possible to play CCIR tapes so they sound as we expect NAB-equalized tapes to sound. This is, as far as we know, unique to the Citation A. In fact, we know of no presently existing recorder in which the equalization can be changed readily to accommodate the CCIR curve. Even though most tape recorders used by non-professionals employ their own amplifiers, the advantage of using the tape-head input direct from the head itself eliminates one other potential source of distortion, in addition to giving a wide range of control direct from the panel.

Measurements

We—both ourselves and our readers—are sufficiently experienced with equipment of various types to be slightly skeptical of the specifications offered about performance, and we do not usually accept them at their face value unless we have verified them to our own satisfaction. After enough measurements have been made, one soon learns whose specifications to believe wholeheartedly. We found out some time ago, for example, that the claims for the Citation I and Citation II were completely substantiated by our own measurements, even though we do not have laboratory equipment that is thoroughly comparable with that at the factory. However, even the most economical equipment is capable of being checked, and if such checking is done at sufficiently close intervals, one is able to feel a certain amount of reliance on the actual measurements.

Thus when we read that the Citation A had harmonic distortion which was unmeasureable at rated output, we felt that it was necessary to find out for ourselves. Rated output is 2 volts, and maximum output is claimed to be 6 volts. We made distortion measurements at 20, 100, 1000, and 7500 cps. At 1000 cps, for example, we found distortion to be .06 per cent at 2 volts output. Then we checked the generator alone, and found the distortion to be .06 per cent. Trying again, we found that figures agreed in this same fashion at all of the frequencies measured. Then we tried at 3 volts, and still distortion measured .06 per cent; also at 4 volts output, and again .06 per cent. At 5 volts, the measurement increased to 0.1 per cent, and at 6 volts, it was 0.9 per cent. Similarly, IM distortion was below 0.1 per cent at 2 volts, increasing to 0.3 per cent at 4 volts, and slightly over 1 per cent at 5 volts.

With a signal of 0.36 volts to the tuner input, we measured an output of 2.0 volts at 10 cps, and also at 100, 1000, 10,000, and 100,000 cps. While the amplifier is claimed to be flat up to one megacycle, we had no generator which went that high. But we would settle for flat response up to 100,000 cps any time.

On the mag phono inputs—two are provided—we found that an input of 2.2 mv gave the rated 2-volt output, slightly more than the specification. All phono curves measured within ±1 db from the indicated values, as was to be expected. Tape curves measured in accordance with the NAB curve at a given setting of the adjustable control—the latter giving a turnover variable from 1500 to 5500 cps. Hum and noise measured 66 db below 1 volt with the volume control set for an input of 5 mv and an output of 1 volt on phono, and on the high-level positions the figure was 78 db below 1 volt with the volume control set for a 1-volt input signal. The front-panel phone jack is apparently in parallel with the output of the preamp. Output and phone-circuit impedances measure in the vicinity of 300 ohms. The output signal is adequate to feed either high level phones or the more usual low-level units.

FISHER FM-STEREO BROADCAST MONITOR, MODEL FM-1000

The FM-1000 is really not the usual type of FM-stereo tuner—neither by design or function. Indeed the only reason for us to examine and report about it is that it represents a level of performance at least an order of magnitude above most available FM tuners. Before continuing further, and raising your hopes needlessly, it should be pointed out that the FM-1000 is priced in the "over $400" category. In other words, this is a professional piece of gear and will be of interest mainly to broadcast stations and those audiofans with firm convictions and a rather large amount of assets.

Actually, another reason for reporting about this instrument is that it proves something we have been saying for some time: that there is often more to a piece of equipment than is revealed by the specifications. For instance, consider the rated IHFM sensitivity of the FM-1000—1.5 μv. By itself this number tells us that this instrument is capable of receiving a station even with a relatively low signal level. There are many tuners available which can handle such small signals. We could go on from here and point out that each one of the technical specifications of the FM-1000 can be, and is, matched by other available tuners, and yet very few sound as well as this one does. The significance of this digression is that specifications go a long way towards describing an electronic instrument of this kind, but there is a combination of rather minute and difficult-to-measure variables which finally *determine* excellence. On top of that, the excellence we are referring to often requires an AB comparison in order to be distinguished from the very good; the two instruments have to be playing almost at once.

Response curves are not shown from the measured unit—we prefer to withhold them until we construct the Citation A from a kit—probably in two or three months. In the meantime, we shall be more than content with the performance and listening quality of the factory-wired unit. **L-20**

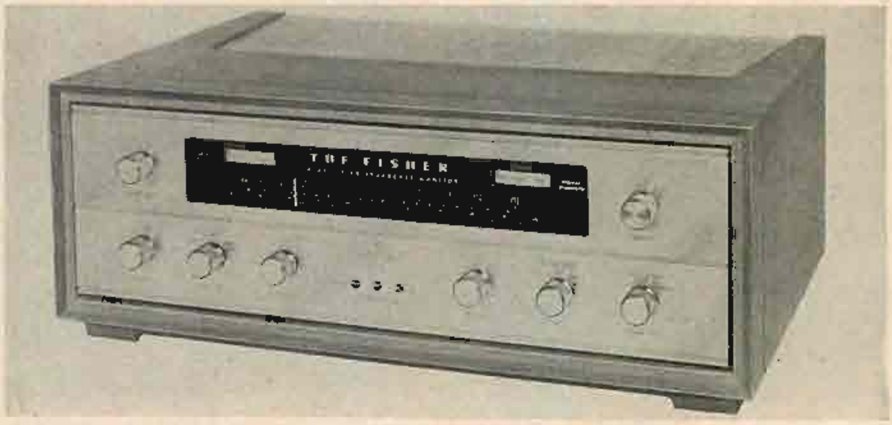
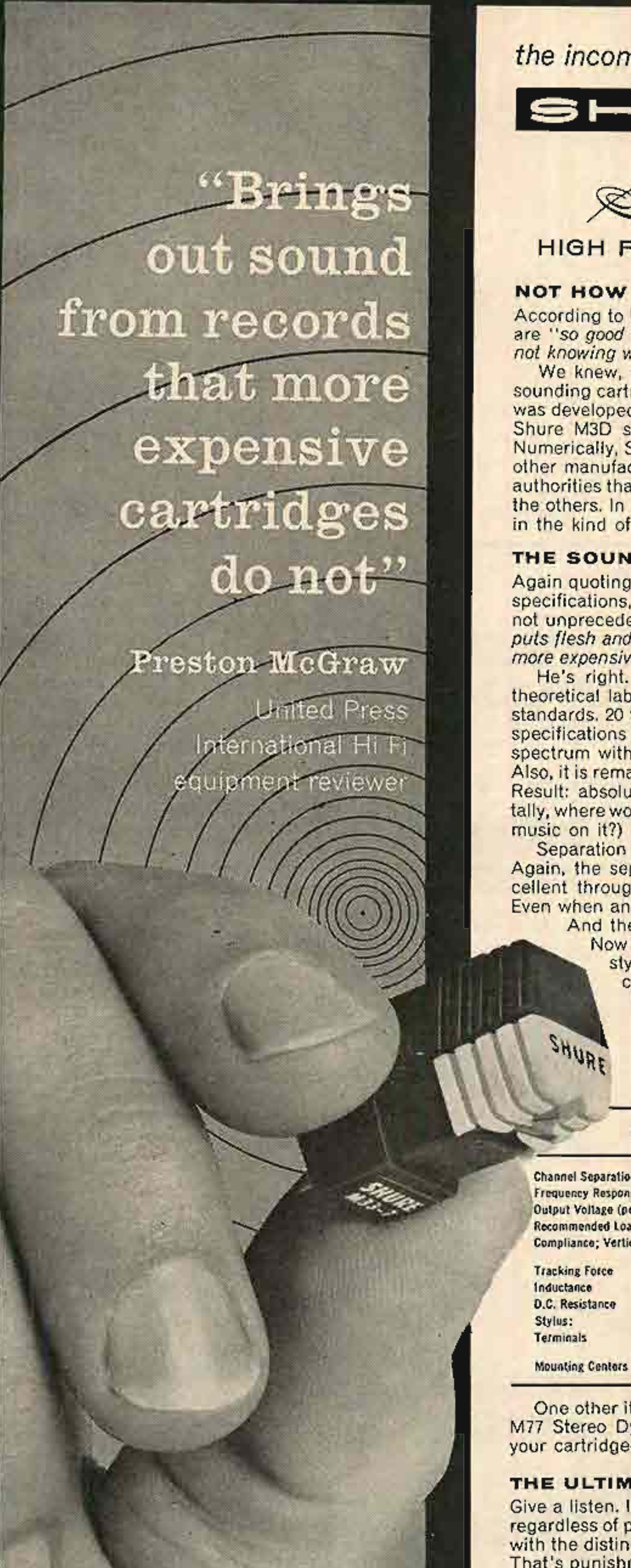


Fig. 3. Fisher FM-Stereo Broadcast Monitor, Model FM-1000.



"Brings out sound from records that more expensive cartridges do not"

Preston McGraw
United Press
International Hi Fi
equipment reviewer

the incomparable new

SHURE SERIES M33

Stereo Dynetic®

HIGH FIDELITY PHONOGRAPH CARTRIDGES

NOT HOW MUCH? BUT HOW GOOD?

According to United Press' Preston McGraw, the Shure series M33 cartridges are "*so good that a hard-shelled listener might suspect Shure engineers of not knowing what they had when they hung a price tag on them.*"

We knew, all right, Mr. McGraw. It's just that we don't believe the best sounding cartridge need be the most expensive. The new Series M33, after all, was developed by the same team of engineers who developed the redoubtable Shure M3D series . . . the world's first truly high fidelity stereo cartridge. Numerically, Shure has made *more* highest-quality stereo cartridges than any other manufacturer—and they're used by more critics and independent hi-fi authorities than any other. Chronologically, Shure had a two year head start on the others. In short, Shure has learned how to make these critical components in the kind of quantities that result in lower prices.

THE SOUND OF SPECIFICATIONS

Again quoting Mr. McGraw: "Professional engineers are largely impressed by specifications, and the specifications of the M33 (except for compliance) are not unprecedented. *But the way it sounds is something else again. The M33 puts flesh and bones on specifications. It brings out sound from records that more expensive cartridges do not.*"

He's right. To begin with, Shure specifications (as published) are not theoretical laboratory figures, or mere claims . . . they are actual production standards. 20 to 20,000 cps. response may appear average. But what the bare specifications don't show is that the M33 series goes right through the audible spectrum without a hint of the break-up prevalent in most other cartridges. Also, it is remarkably free from disconcerting peaking at this frequency or that. Result: absolutely smooth, transparent, *natural* sound re-creation. (Incidentally, where would you find a record that goes from 20 to 20,000 cps. with genuine music on it?)

Separation is over 22.5 db. at 1000 cps. Much more than necessary, really. Again, the separation figure doesn't show that the M33's separation is excellent throughout the audible spectrum. No cross-talk between channels. Even when an oboe plays.

And the matter of compliance: 22 x 10^{-6} cm. per dyne for the M33-5. Now there's a specification! According to Mr. McGraw, the Shure stylus feels like a "loose tooth." And so it should. The incredible compliance of the M33-5 gives it the ability to respond instantly to the manifold and hyper-complex undulations of the record groove. Superior sound is one outcome of the superb compliance. Another is the ability to track the record at low force. *The M33-5 will track at forces as low as any other cartridge on the market today.*

SPECIFICATIONS	M33-5	M33-7
Channel Separation (at 1000 cps)	Over 22.5 db	Over 22.5 db
Frequency Response	20 to 20,000 cps	20 to 20,000 cps
Output Voltage (per channel, at 1000 cps)	6 mv	6 mv
Recommended Load Impedance (per channel)	47,000 ohms	47,000 ohms
Compliance; Vertical & Lateral	22.0 x 10^{-6} cent. per dyne	20.0 x 10^{-6} cent. per dyne
Tracking Force	¾ to 1.5 grams	1.5 to 3 grams
Inductance	600 millihenrys	600 millihenrys
D.C. Resistance	750 ohms	750 ohms
Stylus:	.0005" diamond	.0007" diamond
Terminals	4 terminal. (Furnished with adapters for 3-terminal stereo or monaural use.)	
Mounting Centers	Fits Standard ½"	

One other item: if your tracking force is 4 to 6 grams, the even lower cost M77 Stereo Dynetic will deliver the best sound you can possibly get from your cartridge-arm combination.

THE ULTIMATE TEST

Give a listen. In fact, compare the Shure M33 series with any other cartridge, regardless of price, in A-B tests (we do it all the time). If you are not impressed with the distinct difference and greater naturalness of the Shure, don't buy it. That's punishment enough for us.

PRICES:

Why spend more than you must? M33-5 and M33-7 net for $36.50 The M77 is only $27.50

If you *insist* on Shure when you buy, you can *demand* more from the rest of your system when you play . . . write for literature, or still better, hear them at your high fidelity showroom: **Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois.**

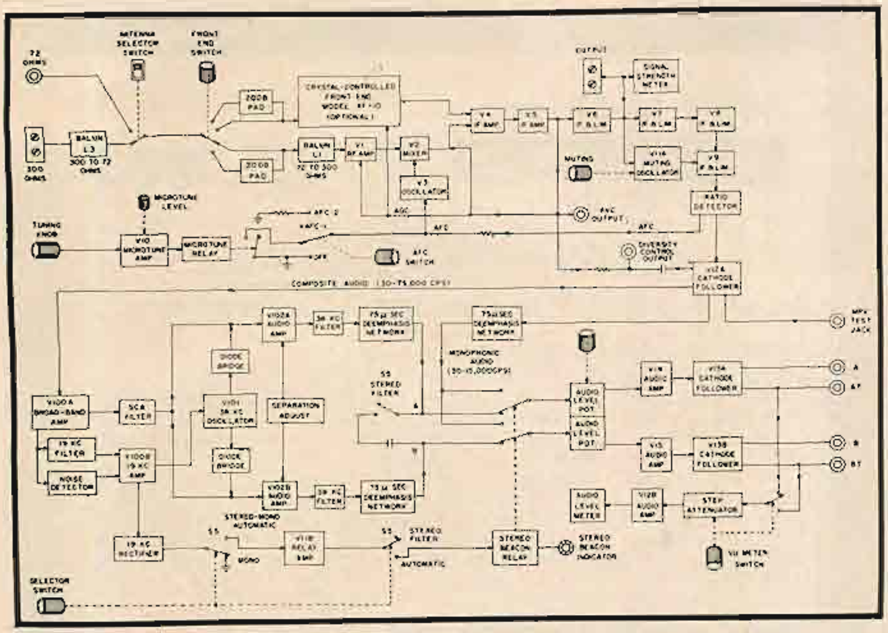


Fig. 4. Block schematic of the Fisher Broadcast Monitor.

One may well ask why we have spent so much space to describe the inability of specifications to indicate small but significant differences in performance. The answer is simple; we are making the by now obvious point that it is possible to miss out on a superlative instrument by "buying specifications." The solution is to be guided by specifications *and your ears.*

Now back to the FM-1000. Some of the features of this unit are: a VU meter to indicate audio level; a signal strength meter; automatic switching between stereo or mono reception; a stereo beacon which automatically indicates that a stereo program is being broadcast; "Microtune" which automatically cut off a.f.c. while tuning, and automatically cuts it back in after the hand is removed from the tuning dial; provision for crystal control of the front end for use as a broadcast monitor; and a muting control. In addition, the FM-1000 will accept either a 300-ohm or 72-ohm antenna lead.

Operation is quite simple in spite of the rather formidable lineup of controls, lamps, and meters shown in *Fig.* 3. In fact, except for the need to read audio level from time to time, most controls are set and not touched after the initial adjustments. For this reason we would like to see those little-used controls hidden behind a swing-down door as they do in their new control amplifier (Model 101-C). Even engineers can appreciate functional placement of the controls.

Circuit Description

The following description is illustrated in the block diagram shown in *Fig.* 4.

The signal from the antenna is fed to either the 72-ohm or 300-ohm inputs. The balanced 300-ohm input is converted to 72 ohms unbalanced by a balun, L_3. Then the signal goes through S_1 where it is directed through either the tunable or crystal-controlled front end. S_1 also can insert a 20-db resistive pad at this point to prevent overloading due to strong local signals. From S_1 the signal is coupled to the 300-ohm unbalanced input of the tunable front end through balun L_1. Baluns L_1 and L_3 also attenuate car ignition and other interfering signals. From L_1 the signal goes through a tuned circuit to V_1 (ECC88/–6DJ8), a cascode r.f. amplifier. Then they are fed through a double-tuned circuit to the 6CW4 Nuvistor mixer stage V_2. The oscillator stage V_3 is also a 6CW4. Now the signal goes through six i.f. stages, the last four of them serving as limiters Five of the i.f. stages are 6AU6 pentodes. The grid-bias voltage of i.f. tube V_7 is used to drive the tuning meter and to control the muting circuit.

The Microtune circuit amplifies hum picked up by the tuning knob when the hand touches it. The amplified hum is used to activate relay K_1 which in turn grounds the a.f.c. line and at the same time breaks the circuit to the a.f.c. indicator lamp on the front panel.

The multiplex section recives the audio output of the ratio detector through a cathode follower. The composite signal is fed to a time-division network where the left and right signals are detected and fed to the audio output section. The audio section consists of two EF86/6267 pentodes, one for each channel, and a dual-triode cathode follower (ECC88/6DJ8). The output from each cathode follower is applied to a VTVM circuit, through a step attenuator, which drives the VU meter.

Performance

As expected, the FM-1000 meets all of its specifications without difficulty (we did not test it with a crystal-controlled front end). We will not list these specifications because they are truly beside the point; the point is that the FM-1000 produces excellent sound. In fact it is one of the cleanest we have heard in recent months. On the other hand, as we noted before, the price is commensurate with the quality—both are high. L-17

WEATHERS "66" TURNTABLE AND PICKUP SYSTEM

It has been at least five years, probably more, since Weathers pioneered the concept of a very light turntable driven by small precision motors. Also, a good many years have passed since they introduced a wood arm utilizing the viscous-damping principle. Now we have the opportunity to examine the latest effort from the Weathers organization—the Model 66.

The appearance of this system is rather startling; it reminds us of those ingenious clocks which seem to have no visible drive mechanism. At first glance it is hard to figure out where the motors are, and even when we know, it is still hard to figure out how they could be fitted in such a compact space. Note that there are two motors, mounted diametrically opposed, so that sufficient torque is provided to drive the turntable at constant speed even with a dust-removing device installed. We mention this because some previous models were inclined to slow down when loaded by some types of dust cleaners. While we are mentioning changes, we should note the mercury power switch. This type of switch eliminates all clicks and pops, both electrical and mechanical, usually attendant to turning power on or off—a valuable feature for recording.

The "66" is a complete turntable and stereo pickup system with a ceramic cartridge which proves the case for this type of cartridge, in the high-fidelity field. Since it is a ceramic cartridge, it can be fed directly to the auxiliary inputs, or with the supplied network, to the magnetic cartridge inputs. One of the advantages of the ceramic cartridge is the improved signal-to-noise ratio resulting from the much higher signal output (than the magnetic cartridge).

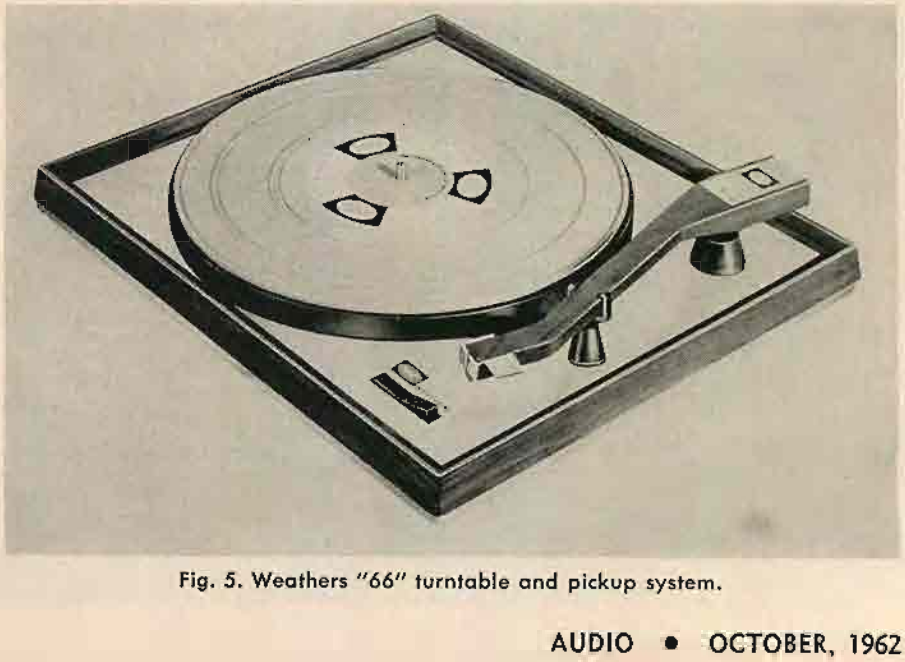
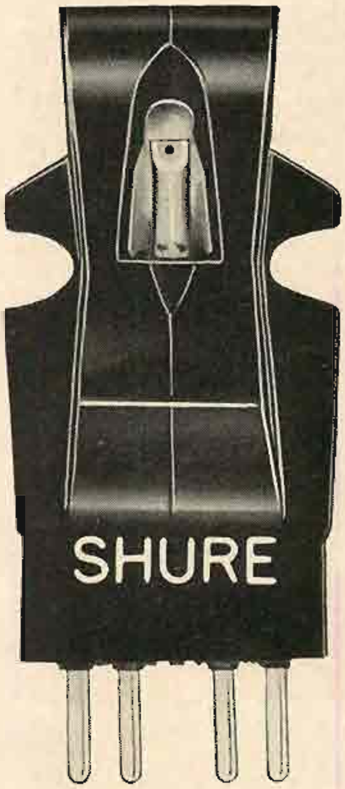


Fig. 5. Weathers "66" turntable and pickup system.

which twin has the phoney ?

(stylus, that is)



your eye can't tell . . . but your ear can

PRICE VS. PERFORMANCE

Ruskin said it: "There is hardly anything in the world that some man cannot make a little worse and sell a little cheaper and the people who consider price only are this man's lawful prey." Hear, hear. And not being ostriches, we admit to having seen so-called "stylus replacements for Shure Cartridges" selling for less than genuine Shure Dynetic® Replacement Styli. We bought several and examined them:

LABORATORY FINDINGS

Shure laboratory tests show that the imitation stylus assemblies labeled as replacements for the Shure Model N7D Stylus Assembly vary drastically in important performance characteristics. For example, the compliance varied from a low of 0.9 to a high of 11.5, requiring 9.0 grams to track a record with a low compliance stylus, and 2 grams with a high compliance stylus. The high compliance stylus retracted at 4 grams needle force, allowing the cartridge case to drag on the record surface, thereby becoming inoperative. Response at high frequency (relative to the 1 kc level) ranged from a 5.5 db peak to a drop of 7.5 db. Separation varied from "good" (27 db) to "poor" (16.5 db) at 1 kc. These figures reveal that *there is very little consistency in performance characteristics of the imitation Dynetic Styli.*

In each of the categories shown above, the results ranged from good to poor. As a matter of fact, only 10% of the samples met the Shure performance standards for the Shure N7D Stereo Stylus.

A DIAMOND IS A DIAMOND IS A DIAMOND

Time was when the stylus price was measured by its tip—diamond, sapphire, ruby, etc. All good styli have diamonds today—and it is *no longer an important determinant of price.* Shure Dynetic Styli, for instance, are precision crafted throughout and each is painstakingly inspected dozens of times before it is shipped. Tolerances are incredibly rigid. Rejects are high. These standards and procedures are expensive . . . but, we feel well worth the time, labor and expense because the stylus is, in fact, the *major* factor in the Shure Stereo Dynetic's reputation for unvarying high quality, superb performance, and utmost record protection. Obviously, if you use an imitation Dynetic Stylus, we cannot guarantee that the performance of your Shure cartridge will meet published specifications.

SHURE PROTECTS YOU

Shure offers a full one year guarantee on all Dynetic Styli covering workmanship and materials. And, in addition, Shure protects you in the event of damage through your mishandling the stylus. Repair costs are nominal . . . for the life of the stylus! (This does not cover normal and expected needle tip wear.) When to replace the stylus? No safe "number of hours in use" can be given—however, with normal use, we suggest a new stylus about every 18 months—it pays for itself in increased record life. Or, ask your high fidelity dealer to inspect your stylus periodically.

insist on a genuine

SHURE

Stereo Dynetic®

HIGH FIDELITY PHONO STYLUS

Literature: Shure Brothers, Inc.
222 Hartrey Avenue, Evanston, Illinois

look for this wording on the box:

"THIS DYNETIC® STYLUS IS PRECISION MANUFACTURED BY SHURE BROTHERS, INC."

The Turntable

For a turntable of this quality, the Weathers is probably the least space-hungry unit of any we know. The primary reason for this compactness is the extremely light turntable platter and the resultant small drive motors required. Most of you are undoubtedly familiar with the new approach to turntable design indicated by these facts; the turntable is actually very light although it is relatively massive when compared with the rotor of the motor. In operation, the platter rotates on a spindle with a polished spherical bearing surface on either end. Each spherical surface rides on a thrust bearing which is housed in a brass spindle housing. The spindle is about 3/16-in. in diameter and is centerless ground to provide a highly accurate bearing surface which is matched by the precisely bored hole in each brass spindle housing. In fact the fit is so precise that we experienced difficulty in removing the spindle from the housing—although it rotated freely.

An advantage of the lightweight planter is the relatively short delay required to attain operating speed. This, coupled with the fact that the motors will rotate backwards, makes it extremely easy to "cue" with this turntable. One need only rotate by hand until a particular location is reached, back off ¾ of a turn, and release on "cue".

The Pickup System

The system includes a carved walnut viscous-damped arm, and a ceramic-type cartridge, as previously noted. The arm, because it is viscous-damped, descends gradually to the record surface when released. This prevents damage to both the stylus and the record, due to the pickup accidentally dropping. More important, it prevents the pickup from "skipping grooves" when the turntable is subjected to mild shocks. In addition, it is great fun to amaze your friends by casually flipping the arm towards a particular section of the record and walking away as it settles gracefully and gently.

The cartridge contains a pair of ceramic elements, coupled through a soft linkage to the stylus armature. Movement of the stylus stresses the elements and generates a varying voltage. The cartridge is extremely easy to remove and replace and is very small compared with most cartridges one sees about.

The stylus force of the unit we tested was just under 1 gram. The manufacturer claims that it can operate well at much less. The "secret" is in the extremely high compliance and low moving mass. Of course, this is not an unmixed blessing—the stylus must be kept scrupulously clean. On the other hand, the increased record life is well worth the slight inconvenience of periodic "tip cleaning."

Performance

Now we are at the crux of the matter —how well does this system perform? First let us dispense with the obvious— the Weathers Model "66" meets, or exceeds, its published specifications, which are quite excellent: speed 0.05 per cent fast; flutter and wow 0.05 per cent maximum; resonance of arm system 14 cps (damped); frequency response plus or minus 1 db from 20 to 20,000 cps; channel separation 35–40 db from 20 to 15,000 cps; distortion unmeasurable using standard test records; and so on. In reality the Weathers "66" faithfully reproduces the recording without adding the slightest amount of coloration. L-22

ELECTRO-VOICE STUDIO MONITOR SPEAKER SYSTEM, SENTRY II

This speaker system is designed, and intended, for a rather special application: as a monitor speaker in broadcasting studios. The *raison d'etre* for this system highlights a significant but rarely considered problem for the audiofan.

To understand this problem we must first understand how monitor speakers affect the broadcast sound. In its simplest application, the broadcast engineer listens to a program as it is being broadcast through his monitor speakers. Because of what he hears, he adjusts the controls on his console to provide the best sound. Under these conditions, any deficiency of the speaker may show up (negatively) in the broadcast. Thus, all broadcasts from this station may have a built-in "monitor bias."

In more sophisticated cases, the tapes used for a broadcast may have been monitored during the recording session by a speaker with either high distortion or poor frequency response—or both.

This problem, as stated, is not rare! From our own experience, plus the experience of companies dealing with broadcasting stations, it is not even uncommon. We had observed inexpensive speakers in studios over a long period of time before the significance struck us. It is our understanding that some broadcasting studios, over the years, had rejected very good microphones in favor of units of poorer-quality because the test had been monitored over an inadequate speaker system. In fact we have arrived at the reason for the introduction of the Electro-Voice Sentry II (and Sentry I—the wall-hung version).

The system consists of two speakers and a built-in crossover network which includes an impedance-matching transformer so that the speaker may be used with impedances of 16, 150, and 600 ohms. The low end of the frequency spectrum is handled by a 12-in. woofer and the high end by a compression tweeter. The enclosure comes unfinished but sanded and sealed. Power handling capacity is 20 watts.

Fig. 6. Electro-Voice Sentry II studio monitor speaker system. Intended for professional applications, the unit has an exceptionally flat response curve, as shown in Fig. 7.

A Flat Sound

We can observe from the response curve shown in *Fig.* 7 that the Sentry II is unusually flat in response. In addition it sounds quite good to our ears. We suspect, however, that many people would not be quite so pleased with the sound—primarily because they are not used to a flat speaker system; whether by design or by accident, the sound reproduction systems we are forced to hear most of the time are far from flat. For this reason, many people would find the sound of the Sentry II a little strange, and therefore not to their liking, until they lived with it for a short time. After that, the over- and muddy-bass common to less accurate speaker system sounds unacceptable. In monitor booths, the usual listening level is higher than in the average home, so the Fletcher-Munson deficiency of the ear does not become apparent. Of course, on its own merits the Sentry II is truly good sounding, handles transients well, and has a tight bottom. And it can very well solve the problem in the broadcasting studio. L-23

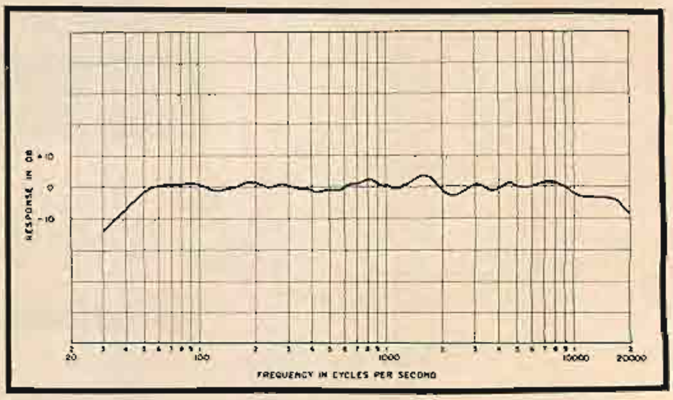
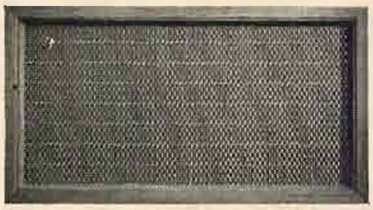


Fig. 7. Response curve for the Sentry II loudspeaker system.

we didn't know our bass was dangerous

(even at a distance of thirty feet!)



When the EMI Model DLS-529 bookshelf loudspeaker was first introduced, we said it was a "dangerous loudspeaker." We even described the speaker's dangers in minute detail. Now we find it is dangerous even beyond our imagination. The worst part is that someone else had to warn us.

High Fidelity magazine recently tested the DLS-529 and reported it smooth and well-balanced "throughout its range which is estimated to extend from about 30 cps to beyond audibility." That's true. Its frequency response is far greater and far smoother than many speakers costing twice as much.

The journal also stated that the DLS-529 "does not need much amplifier power to produce a good deal of bass response." That's right. The bass-producing capability of the speaker is unique. Other bookshelf types, and some larger systems, need a minimum of 25 watts of amplifier power to drive their speakers effectively at very low frequencies.

High Fidelity tells of driving the DLS-529 with a 60 watt amplifier. The pre-amplifier was set "just past the '12 o'clock' position" and "enough bass power was radiated to set up vibrations in a cabinet door located some thirty feet away from the speaker." And therein lies an unrecognized danger of the dangerous loudspeaker.

The lesson is obvious. If your penchant is for Bach organ works, be especially careful. Every pedal note will roll through your listening room as if in a cathedral.

Music, heard through a top-flight system with true fidelity loudspeakers, is meant to be felt as well as heard. The renowned designer of the DLS-529, Dr. G. F. Dutton, understood this very well. He deliberately constructed the speakers to recreate the feeling, plus the purely-auditory experience of concert hall listening. Enjoy it. But if your cabinetry loosens, remember...we warned you.

One more thing. Extreme highs may not make their presence felt as dramatically as extreme lows, but they are quite important. The smooth, balanced response to "beyond audibility" (as High Fidelity termed it) bestows an exciting quality and a liveness on reproduced sound that can be felt as surely as powerful bass. This smoothly-balanced response over the entire frequency range first made us realize that the DLS-529 was dangerous because it demands a reappraisal of previously accepted standards of excellence.

And now...dangerous because the "physical feel" of its bass response transports the listener out of the listening room and into the concert hall.

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CHARLES A. ROBERTSON

STEREO

Glen Gray: They All Swung The Blues!

Capitol Stereo ST1739

This is the fifth volume in the "Sounds of the Great Bands" series, a project being carried out under the direction of Glen Gray by the Casa Loma orchestra, formed from a seasoned bunch of big-band refugees now located in Hollywood studios. The sounds are the greatest yet, either because of the length of time the band has worked together or the choice of the blues as topic of conversation. The previous recreations of hit arrangements and famous solos were all performed with professional polish, and the recorded fidelity is something that was unattainable during the swing era. But few studio groups are able to match the spirit developed through hours of rehearsal and days on the road. The Casa Loma crew came close more often than not, and this time out plays tributes to Tommy Dorsey, Jimmy Lunceford, Count Basie and Duke Ellington as though it had just finished a six-month engagement at the old Palomar Ballroom in Los Angeles.

The work of original bands is surpassed in some cases, notably on *Tango Blues,* which failed to attract much attention in the Harry James version. Too delicate to stand up against a crop of flagwavers, the tune flourishes under Gray's loving care and the fancy trumpeting of Joe Graves. Also revitalized above the call of duty are Gray's *No Name Jive,* and Glenn Miller's 1939 recording of *Farewell Blues.* As Floyd Smith used one of the earliest amplified guitars with Andy Kirk on *Floyd's Guitar Blues,* the sound of Alvino Rey's modern electronic instrument is hardly the same. Prominent among the soloists are Shorty Sherock, Mannie Klein, Babe Russin, Milt Bernhardt, Ray Sherman and Irv Kotler, but the star performer is Abe Most, who confidently assumes clarinet roles once played by Benny Goodman, Barney Bigard and Woody Herman.

Hugh Romney: Third Stream Humour

World-Pacific WP1805

The Modern Jazz Quartet & Guests: Third Stream Music

Atlantic Stereo ALC1917

(4-track UST tape)

John Lewis: Jazz Abstractions

Atlantic Stereo ALC1918

(4-track UST tape)

About the only connection between humor and third stream music until now was the dead seriousness of the introductory prospectus and most explanatory writing on the subject. Even those musicians and critics who refused to accept the precepts as outlined couched their objections in the terms of a scholarly treatise. That many classical composers, including the contemporary experimenters with "musique concrete" and other futuristic projects, have a humorous side seems to be forgotten. Although Hugh Romney never touches upon the joining of jazz and classical techniques, the mere fact that he mentions third stream in the same breath with humor, even in the British spelling should be encouraging. Some listeners may see a significance in the closing of the Renaissance on the night the discourse was delivered. The Hollywood club was about to be boarded up prior to being torn down to make way for a new Playboy Club. After all, there are people who fail to see anything humorous in sex.

Romney's brand of comedy places the old-fashioned gag in juxtaposition with an original and highly cerebral type of fantasy. In the brief but lively autobiography on the liner, his antecedents are disclosed only back as far as his World War II discharge in Paris. He has moved in bohemian circles since then, first in Europe and then in the United States, painting at the Beaux Arts, studying dance with Martha Graham, reciting poetry to jazz in Boston, and attending a school for acting in New York. Instead of copying the school of sick comedians, he ignores politics, topics of the day, dirty words and psychoanalysis. Before talking on the telephone during a sketch, he would probably try to communicate by extrasensory perception. While fully acquainted with hip language, he has moved a stage beyond and only drops into the argot when necessary. When at his best, Romney operates in his own strange world of dreams, Buddhism and Zen philosophy. His more mundane gags always draw audience laughter, but they often seem out of place, just as a rehearsal of third stream music would be disrupted by a Kid Ory trombone blast. But the laughs do bring everybody back down to earth.

The two albums responsible for starting all the third stream furor are now available on four-track stereo tape, and they belong in the library of everyone who thinks seriously about contemporary music. Unreconstructed humorists can always doctor the tape by overdubbing a Bubber Miley muted trumpet passage or splicing in a J. C. Higginbotham trombone solo at appropriate intervals. Dabblers in "musique concrete" will find much excellent material with which to wreak havoc by altering tape speed and performing other electronic trickery. Perhaps the next innovation to come over the jazz horizon will be something called "jazz concrete," composed entirely on a tape recorder by editing an assortment of prepared tape. In the meantime, a great deal of rare and beautiful music is to be found lurking under all the liner verbiage enclosed with each package and the compositions of John Lewis, Jimmy Giuffre and Gunther Schuller can be enjoyed for their sonic values alone.

Les Double Six Of Paris: Swingin' Singin'

Philips Stereo PHS600026

This talented group from the French capital first arrived in this country on an album that still figures prominently in Capitol lists, but the strange machinations of international exchange brings the second through customs on the Philips label. Since rocketing to instant success, the members have toured in Europe and Canada, with prospects of a trip to the United States in the offing. Mimi Perrin continues to direct and sing one of the two female leads, but her assisting force is apt to be altered according to the demands of the French Army or a singer's sudden whim. Two different groups are involved in the current production, unless it would be correct to make the stereo count four, as recording sessions allow each voice to swing a second time around. The double treatment ensures a full band sound, and rival recordings of Lambert, Hendricks and Ross which enlist only rhythm support seem thin by comparison. The French lyrics also help enormously, and students of the language can have great fun unraveling the plots to Bobby Timmons' *Moanin', Scrapple From The Apple,* and *Night In Tunisia.* Parisians may change women's fashions each year, but no jazz style is ever out of date in the City of Light. The Double Six voices recreate the horn parts in ensembles and solo efforts as though the arrangements were brand new, doing especially well by the Woody Herman recording of *Autumn Leaves.* In this case, the stereo version is a must.

Phineas Newborn Jr.: A World Of Piano!

Contemporary Stereo S7600

Technique is only part of the equipment a jazz pianist should have to become a major force, but the knack for doing the impossible certainly helps. Phineas Newborn burst upon the recording scene in 1956 with an oversupply of outward glitter and virtuosity of a sort not often attained at the age of twenty-five. So perfect was his playing that there seemed to be no room for improvement. The complaints lodged against Newborn by critics and audiences alike were for lack of emotional depth and anything original to say. It was thought that these missing elements could be acquired only by a less ambitious display of pyrotechnics and more economy of style. Newborn fooled everyone by doing just that, and for awhile his rising star was hitched in a position secondary to such leaders as Charles Mingus, Roy Haynes, Teddy Edwards and Howard McGhee. He also moved to the warming climes of Southern California during this period and signed a contract with Contemporary.

Newborn's debut on the label as leader is the first album to bear his name in some time, and again he fools everyone by topping his previous high mark and playing with greater technical brilliance than ever before. Not only do his fingers move over the keys at impossible speed, but they maintain a full touch and give each note the exact degree of tonal value desired. The most dazzling feats are performed during improvised passages on Charlie Parker's *Cheryl,* Clifford Brown's *Dahoud,* Dizzy Gillespie's *Manteca,* and Sonny Rollins' *Oleo.* Any remarks about surface emotion are forestalled by a romantic *Lush Life,* while even the feelings of Wayne King admirers should be appeased by the sentimental waltz Leroy Vinnegar wrote in memory of Carl Perkins. The pianist enjoys support alternately of rhythm teams borrowed from the groups of Miles Davis and Cannonball Adderley, but his own left hand proves to be extremely dependable at keeping tempo. Perhaps the most encouraging sign of all is that Newborn sounds as though his next album will be even better, and well it may if he ventures to include original work. His world of piano is undiminished, and excellent stereo brings it into the home large as life.

Stanley Turrentine: Dearly Beloved

Blue Note Stereo ST84081

Les McCann: Les McCann Ltd. In New York

Pacific Jazz WTC1018

While most young tenor saxists try to make a name for themselves by overtaking established stars, Stanley Turrentine is finding it profitable to relax along the way. Playing for romantic couples at the witching hour can be a rewarding pastime, as Gypsy fiddlers and French accordionists discovered long since, provided a responsive chord is touched at the earliest possible moment. After sessions with Jimmy Smith and a few seasons of practice, Turrentine is quite adept at creating the proper mood and has devised a theme, *Wee Hour Blues,* to start the action almost at once. The lone original included in his latest trio set, it snuggles up beside *Baia,* and *My Shining Hour.* The song selected to title the album has another of Jerome Kern's, *Yesterdays,* as company. So hesitant does organist Shirley Scott become about joining such goings on that she feels it necessary to hide under a pseudonym, but the urgent whisper of Roy Brooks' brushwork soon punctures all reserve. Turrentine, as though to prove his intentions wholly honorable, improvises gently on the spiritual *Troubles Of The World.* Tonal excellence makes his tenor sax a perfect match for organ sounds, and Rudy Van Gelder's engineering blends the two together in stereo bliss.

Les McCann requested Turrentine's presence, during the Los Angeles pianist's inva-

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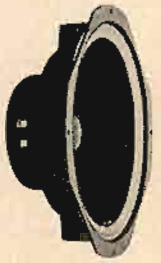

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sion of territory east of the Rockies, when it was decided to enlarge the trio to sextet size and record live at the Village Gate. Already won over by his earlier recordings, New Yorkers turned out by the numbers to hear him play his compositions in person. Being picked for the date is a boost in itself, and Turrentine's splendid performance signifies another upward step. One reason for the rapid ascent is undoubtedly the authority with which he handles different assignments. Trumpeter Blue Mitchell and Frank Haines, also on tenor sax, fill out the guest list, and the program consists entirely of McCann originals. Chapter and verse are added for a revised version of the popular *A Little ¾ For God & Co.,* while the current dance craze is benignly satiarized on *Twist Chacha.* Although audience enthusiasm frequently overflows, stereo enables the sextet to ride out the storm.

The Unpredictable Jimmy Smith: Bashin'
Verve Stereo V8474
Gerald Wilson: You Better Believe It!
Pacific Jazz WTC1018
(4-track stereo tape)

Considering the fact that certain diehards still regard the saxophone as an unnecessary and useless invention, jazz organists might be excused for reflecting with pride on the amount of acceptance gained to date for their electronic plaything. Instead, no busier group of individuals exists in all of jazz, due largely to the prevailing influence of Jimmy Smith, who continues to set a furious pace for the others to follow. The activity started soon after Blue Note recorded Smith some seven years ago in a small Baltimore club. A few talented musicians had managed to play jazz on the organ before then, but the instrument itself remained almost as stately and sedate as ever. Even though it was sometimes cheapened by vendors of popular music in cocktail lounges, jazz players always treated it with awe and respect. All this changed when Smith probed deep into the interior, bashed the outside, and started to wail at fast tempos. The organ became a vehicle for creating jazz rather than an inert medium for relaying ideas conceived elsewhere. A host of new players hastened to climb on board, while seasoned travelers switched over and journeyed down the same set of tracks.

Everyone who traverses this route must work hard, as an open throttle and full head of steam are needed just to keep Smith in sight. The first rule of the road bans copying the methods of another too closely, and the quest for diversity of style leads to intense rivalry. As a result, some of the leading contestants are breaking away from the customary trio or quartet format and taking excursions with larger groups in tow. Richard "Groove" Homes started the trend on the West Coast by propelling a seventeen-piece orchestra under Gerald Wilson's direction, and now the master himself steps out with a band of equal size playing the arrangements of Oliver Nelson.

On loan to Verve for this augmented date, Smith demonstrates entire mastery of various aspects of the jazz organ, from his own patented brand of free wheeling blues to smoldering readings of ballads. A quick summary of his achievements is contained on *Walk On The Wild Side,* which begins with a chorus in pre-Smith style and then gradually incorporates later wide-ranging developments. The master himself, however, seems to be undergoing a mellowing process and is learning to temper youthful exuberance with humor and a vaster display of tonal shadings. This newest stage comes into full bloom on *Old Man River, In A Mellowtone,* and *I'm An Old Cowhand.* Besides fully integrating band and organ, Nelson's scores offer contrasting solos by Joe Newman, trumpet, and alto saxist Phil Woods. Appropriately enough, the same engineer who took portable equipment to Baltimore for Smith's first recording has followed his career all the way. After giving careful attention to the entire Blue Note series, Rudy Van Gelder also moved over to Verve and worked out a proper stereo balance between organ and band. The recording is excellent, and the label should schedule it for release on tape.

"Groove" Holmes can be called an emulator only insofar as his ability to play the blues with Smith's intelligence, taste and feeling is concerned. It is to be hoped that his alliance with Gerald Wilson will continue, as the result of their first session is highly successful and well worth preserving on four-track stereo tape. In addition to freeing the organist from the limited framework of small combos, the partnership also provides Wilson with an escape from writing background music for films and television. While all of his six originals are fresh and imaginative, easily the most appealing is a tribute to a prowling feline called *Blues For Yna Yna.* Tape affords even greater sonic benefits than the previously reviewed versions on vinyl, but both Holmes and Smith require good equipment to show off to best advantage.

Nat Pierce: Big Band At The Savoy Ballroom

RCA Victor Stereo LSP2543

Evidently one of the reasons why the Vik label perished was the order in which releases were scheduled rather than lack of good material in the vaults. It could be that the idea was to meet competition by basing the choice on what the other companies were issuing, but the five-year delay in the release of the currently successful Charlie Mingus Tijuana album indicates that somebody made a mistake. Another case in point is Nat Pierce's memorial to the Savoy Ballroom, as it is far superior to many items carried in the catalogue. One of the last big bands to play Harlem's "Home of Happy Feet," the roster lists such names as Buck Clayton, Paul Quinichette, Frank Rehak, Dick Meldonian and Gus Johnson. Formed as a rehearsal group in 1956, it worked as a unit for six months or more before landing the Savoy engagement. Besides making it possible for the members to get together, the pianist-leader encouraged the more ambitious to try a hand at composing and arranging. Clayton takes credit for three originals, while Pierce contributes one of his own to this 1957 session. The style derives from the way Count Basie used to sound at the Savoy, before the Waldorf-Astoria Starlight Roof beckoned, and the rolling beat make quite a few feet happy. Clayton's trumpet is always a pleasure to hear, and the stereo version is adequate for the time.

MONO

Jimmie Rodgers: Country Music Hall Of Fame

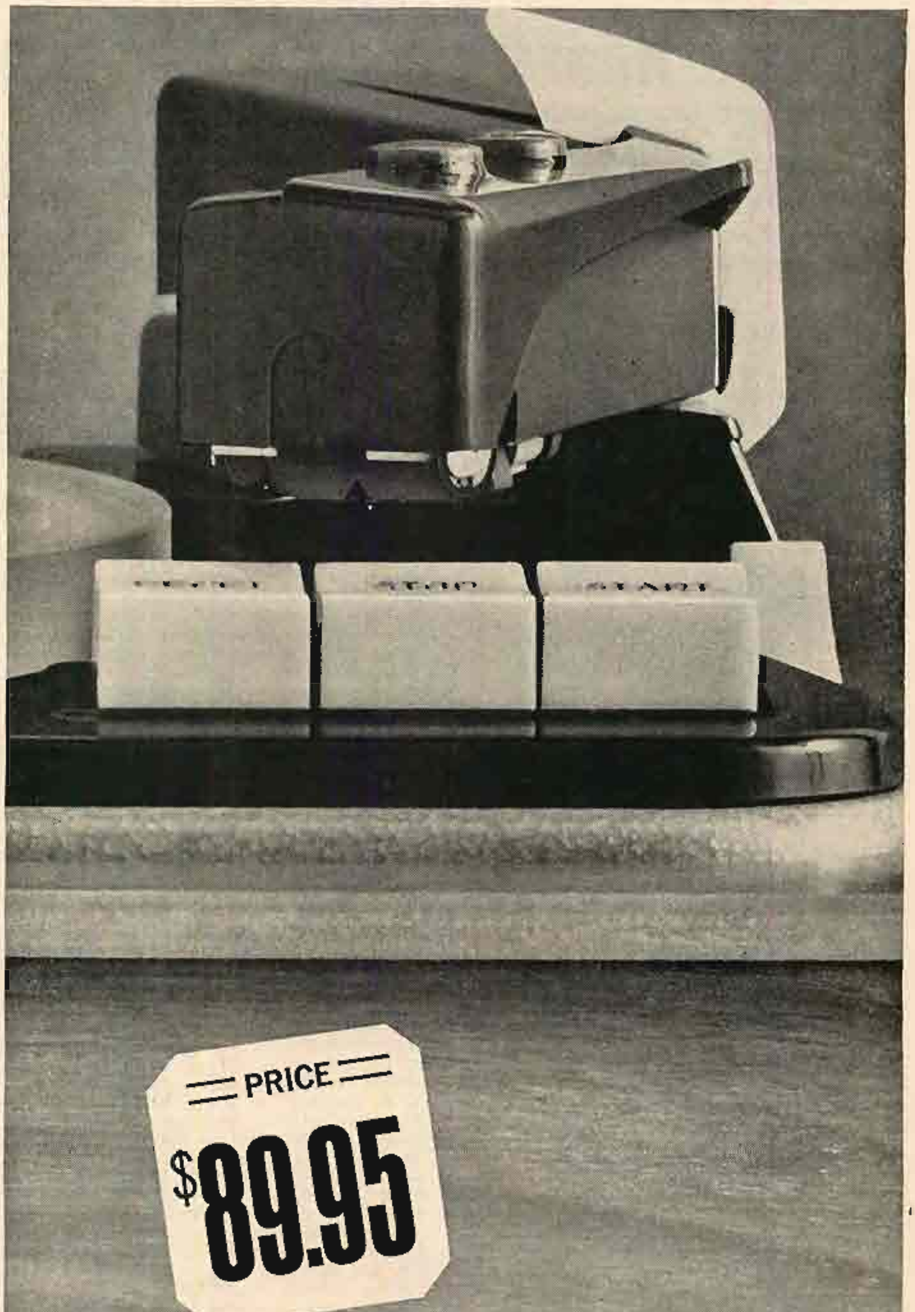
RCA Victor LPM2531

Furry Lewis: Back On My Feet Again

Prestige/Bluesville 1036

Mention is often made of the debt Jimmie Rodgers owed to Negro blues singers without citing specific examples, mainly because they are hard to come across. The blues formed only part of his famed country style, and signs of influence from any source were quickly erased under the spell of his personality. The latest set of Rodgers reissues covers the entire seven years of his brief recording career, starting with the first voice test on *The Soldier's Sweetheart,* recorded by the late Ralph Peer on August 4, 1927, in Bristol, Tennessee. It was during the same year that Furry Lewis, a veteran of traveling medicine shows, recorded for the first time in Chicago for Jack Kupp of Brunswick-Vocalion. After a long period of recording inactivity, Lewis is back in the news again due to the current blues revival and has recent albums on Folkways and Prestige/Bluesville. Direct comparison reveals many interesting similarities between the singers, as well as giving some indication of where the two styles begin to diverge.

Both men mastered the art of understatement, possibly because their voices sound less full and heavy than most blues singers, and the harsh sense of certain verses dealing with life's hardship contain the extra kick of delayed action. A choice example is the use Rodgers makes of falsetto interjections on the classic *T. B. Blues.* At some point during



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their wanderings down dusty byways, both picked up a liking for the twang of Hawaiian guitars from some visiting troupe. Their guitar playing is an amalgam of a variety of styles, and the accompaniments abound in surprises. Entertainment was always part of their business, and their singing combines professional ease with the lonesome air of the roaming balladeer. Rodgers died two days after recording *Old Love Letters,* the last of the album's numbers, but Lewis is on his feet and very much alive at the age of sixty-two. Blues collectors and folk enthusiasts will find much to enjoy, or even to reflect upon, in his versions of *White Lightnin', Roberta,* and *Big Chief Blues.* Æ

LIGHT LISTENING

(*from page 10*)

a better break are represented here. Among the rarities refurbished by Coleman are *Here I'll Stay* from a 1948 show called "Love Life" with words by the then-obscure Alan Jay Lerner and music by Kurt Weill. Equally neglected by the average record producer now covering the Main Stem is the Sigmund Romberg song *Lost in Loveliness* from his 1954 production, "The Girl in Pink Tights." Coleman supplies in his performance of this collection enough fizz to keep this recording an effervescent part of anyone's showtune library.

Living Strings: Sunrise Serenade
RCA Camden CAS 688

Most of the earlier releases in RCA's low-price series by the Living Strings have represented outstanding buys in their price range. The repertory selected for foreign orchestras has been confined to music that did not place too great a demand on the arranging talents available outside the country The sound of the Living Strings series was certainly adequate for the background purposes the procedures had in mind. In this release devoted to tunes made famous by Glenn Miller, it seems to me that the Living Strings have simply bitten off more than their bows can handle. This is not the first time that the Miller classics, in both slow and fast tempo, have appeared on the music stands of outfits other than straight dance bands. Miller fans will recall that post-war recordings made in Germany placed the old favorites in a symphonic setting. The problem here lies in the fact that arranger-conductor Chucho Zarzosa has missed the mark by a wider margin than did the other non-dance band aggregations. Dreamy items such as *Moonlight Cocktail, Serenade in Blue,* and *Sunrise Serenade* fare a little better than the jump tunes in these string translations but the old magic isn't there. A further complication is the seating arrangement of the orchestra. It's difficult to get normal cohesion in the sound of a large orchestra when the setup puts the brasses and reeds at the extreme end of the stage opposite the strings. The indifferent results obtained in this album will hardly deter other orchestras from attempting to keep alive the Miller legend. Anyone examining this release, however, will understand why RCA has just announced another large album of reprocessed recordings by the original Glenn Miller band.

Jack Lacey: Trombone on the Town
M-G-M SE 4010

Oldtimers in the music business who have seen scores of outstanding instrumentalists go unnoticed by record companies will be heartened by the recognition now being given trombonist Jack Lacey. After decades spent in just about every type of musical organization this country has produced, Lacey finally has a chance to showcase his talents in a record built around the sound of his versatile trombone. A listener with even a casual interest in the great dance bands of the past will find in

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COMING!

In the November issue—

1

200-watt Fully Transistorized Stereo Power Amplifier

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72 db of negative feedback around a unique four-transistor d.c.-coupled output stage reduces harmonic distortion to hundredths of 1 per cent.

2

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Erhard Aschinger

Complete design and construction information about a transistorized stereo preamp designed to professional standards.

3

A Headphone Control Center for Monaural, Diotic, and Binaural listening

R. Larson and J. Eargle

A headphone control center incorporating the CBS-Bauer crossfeed network which effectively converts stereo information into binaural information appropriate for headphone listening.

4

Let's Talk About Tape Synchronization

Hal Magargle

All about the various existing techniques for co-ordinating a tape recorder with motion picture film, followed by full information about a simple new system that can be used by anyone.

5

Problems Arising in Playing Stereo Records

E. R. Madsen

An analysis of the distortion resulting from the discrepancy between the vertical angles at which a record is cut and the vertical angle of the playback stylus. How these angles can be standardized is described by the author.

this new release a distinct link with the days when a good instrumentalist was a key figure in any band. No less an authority than Dr. Frank Black, music director of the National Broadcasting Co. during radio's golden period, placed Jack Lacey within that select circle of trombonists that included Tommy Dorsey, Jack Jenney, and Will Bradley.

Shortly after Lancaster, Pennsylvania lost Lacey as a potential taxpayer in the Twenties, he showed up on the stand of a Chinese restaurant in New York as a member of a band known as Oliver Naylor and His Seven Aces. Some time later, Lacey helped Joe Reichman organize a band that went into the Hotel New Yorker where Lacey caught the attention of Benny Goodman. Goodman, only twenty-four at the time, had just formed his first dance band and Lacey was invited to join a Goodman crew that already included Claude Thornhill and Bunny Berigan. Lacey remained with Goodman during the famous "Let's Dance" coast-to-coast radio show that really put the outfit on the map. When the band invaded the recording studios during the mid-Thirties, Benny featured the Lacey trombone in his arrangement of *Cokey* and *Always*. Further refinements in trombone technique were to be found in many of Lacey's pre-war recordings made with the Andre Kostelanetz orchestra. "Kosty" discovered that Lacey had a trick that could make his trombone sound like a French horn when he faced off-mike with a torn felt hat hanging from the bell of his instrument. The arrangements in this recording are the work of Russ Case who played trumpet with Lacey in the Goodman band in 1934. Case has also worked in some fine solo opportunities for the trumpet of Doc Severinsen and the tenor sax of Jerome Richardson. The trombone leads the way in the old tent show favorites *Lassus Trombone* and the Dixie-flavored swing classic *Indiana, September Song, Somebody Loves Me,* and *How Am I to Know* tap a vein of sentimental trombone styling that manages to sound very comforting to these battered ears.

Waltzing with Guy Lombardo
Capitol ST 1738
More Dance Along with Lopez
M-G-M SE 4055

The huge quantity of Lombardo discs in circulation appears to indicate that dancers prefer a familiar sound when they take to the floor. Certainly nothing has changed in the Lombardo style over the decades yet today's middle-aged crowd seems to find it as welcome on the dance floor as it was in their teens. Since only one tempo is featured in this latest Lombardo release. Lee Gillette of the Capitol production staff injected variety in the only way possible. The waltzes are not confined to a single period. Instead, they range from folk tunes such as *Tennessee Waltz* to a Guy Lombard arrangement of *The Swan* from the "Carnival of the Animals" by Camille Saint-Saens. Typical close-up sound that has always been a part of the Lombardo recorded repertory may appear a bit outdated to a young crowd but oldtimers would probably have difficulty recognizing the band in a conventional miking setup.

The Vincent Lopez album covers six dance tempos. Sharing honors are the Fox Trot, Mambo, Dixieland, Twist, Society, and Rhumba. Unlike the Lombardo crew, Lopez has always moved with the current tides in the dance field. During four decades in the business, he has ignored few trends of the moment. When the Original Dixieland Jazz Band left Chicago to play in New York at Reisenweber's, Lopez switched his own style within two weeks—thereby becoming the leading Broadway exponent of Dixieland when the Oiriginal Jazz Band went off on tour. Today's generation of listeners may not realize that the Lopez band, over the years, has included such famous names as Dorsey, Miller, Vallee, Spivak, Cugat, Pastor and Shaw. The band today handles itself in a thoroughly professional manner, displaying its best side in the Fox Trot, Society and Rhumba sections of this album. Both the Lombardo and Lopez sets follow the wider-than-average stereo separation that is used by many dance bands today. Æ

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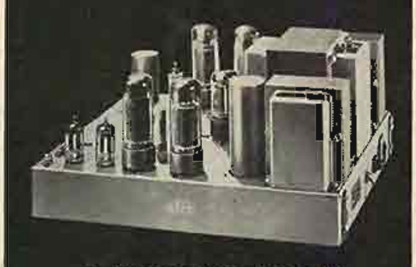

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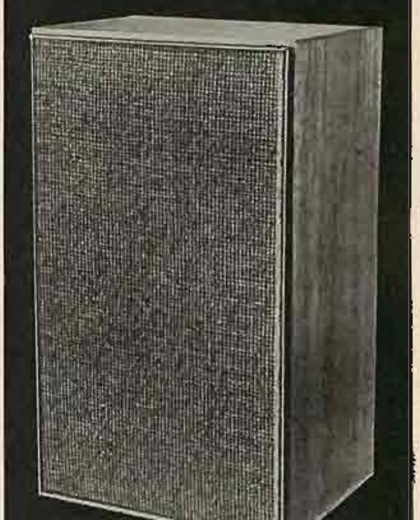

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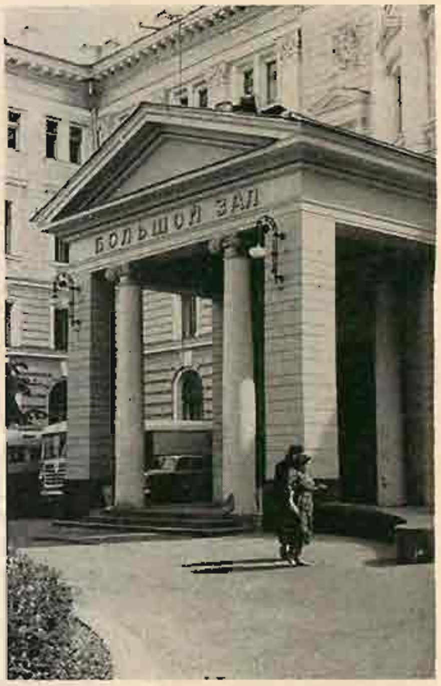
ABOUT MUSIC

Harold Lawrence

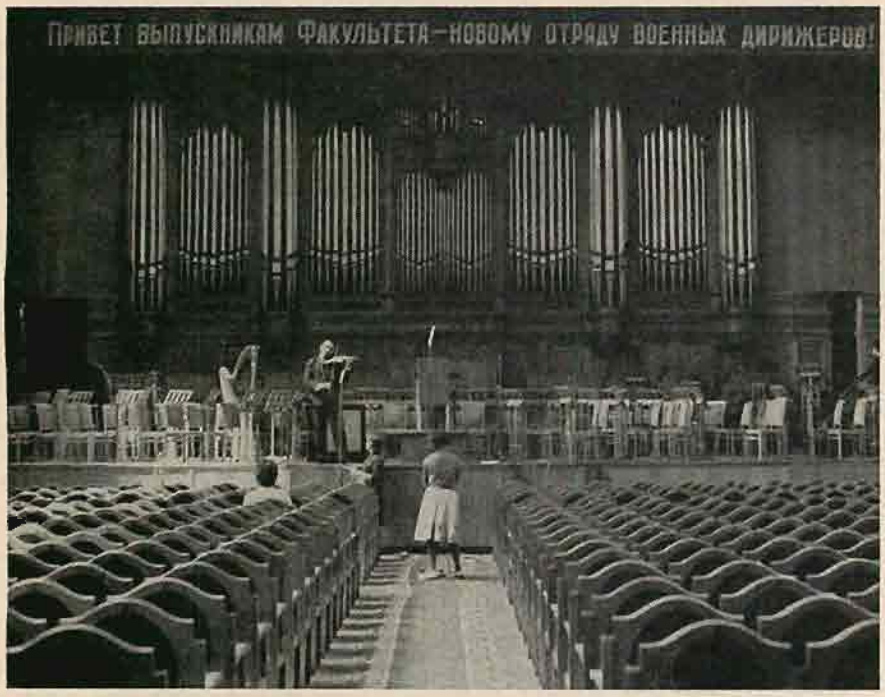
Recording in U.S.S.R.

In June, 1962, a maroon-colored van was driven off a flatcar in a Moscow railway station, into the heart of the Soviet capital, past the swirling domes of St. Basil's Cathedral in Red Square, and down the driveway of the famed Tchaikovsky Conservatory where it was parked outside the stage entrance. Housed inside the truck was a fully-equipped "recording studio," including tape and magnetic film machines, amplifiers, cables, microphones, and monitor speaker systems. The arrival of this recording unit marked a turning point in the history of recording in the U.S.S.R. This was the first time the Russians had permitted a Western company (Mercury) to set up operations with its own technical and musical staff. The Soviet approval came through after no less than four years of negotiations. As musical supervisor of the sessions, the author accompanied the American team.

The photographs on this page and on page 90 were taken at the Tchaikovsky Conservatory by the author.

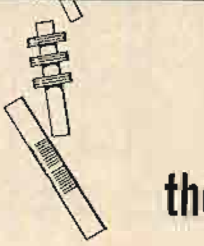


Bolshoi Hall, Tchaikovsky Conservatory, Moscow.


ПРИВЕТ ВЫПУСКНИКАМ ФАКУЛЬТЕТА—НОВОМУ ОТРЯДУ ВОЕННЫХ ДИРИЖЕРОВ!

Above, while soloist practices, women engineers set up for recording session in Tchaikovsky Conservatory. Left, below, Soviet sound technician edits master tape on U.S.S.R.-made tape recorder. Below, three tuners work on piano in preparation for Byron Janis' evening recital.

The pace-setting new S-2100 FM Multiplex/AM stereo tuner



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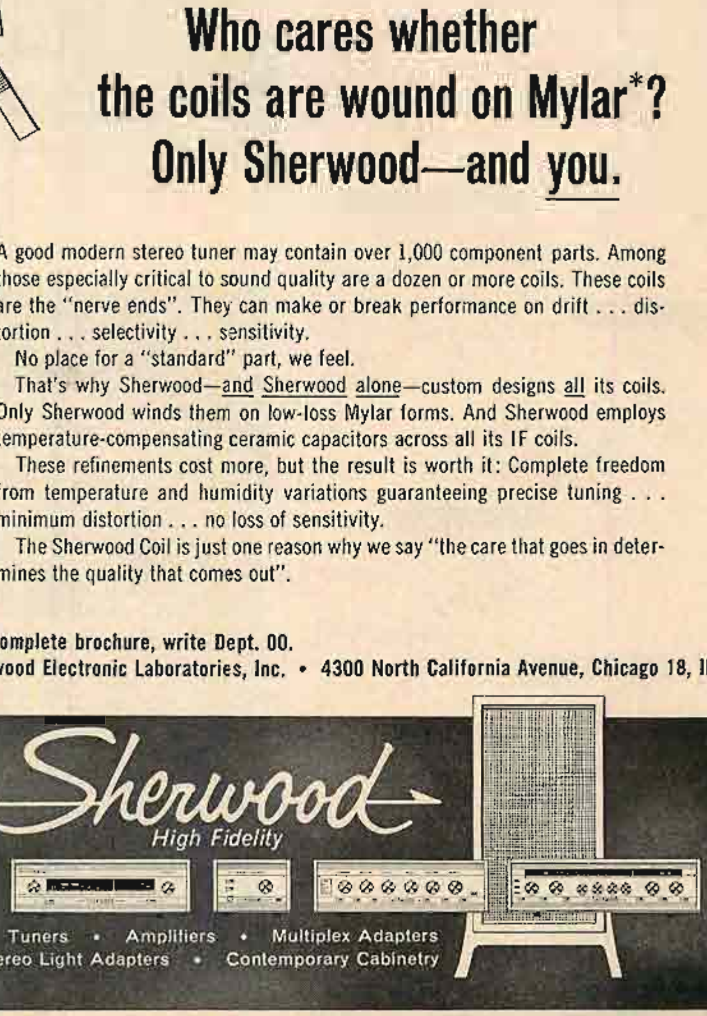

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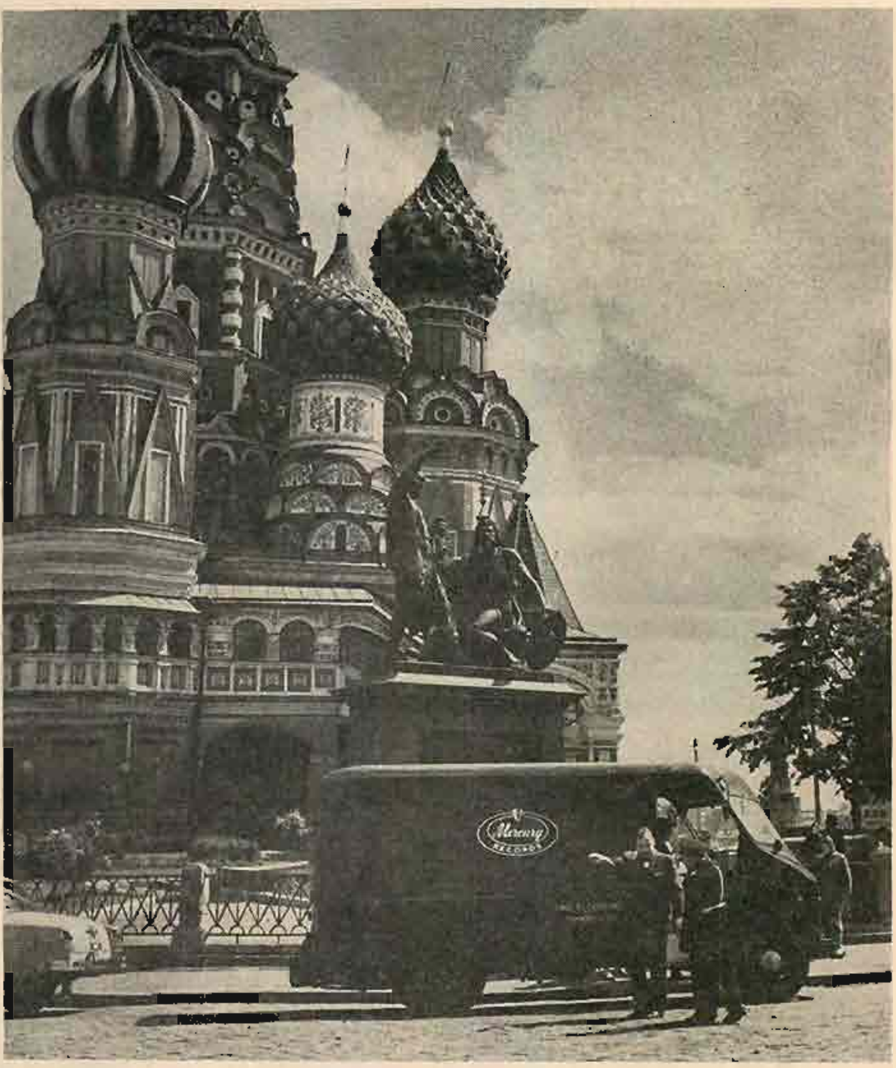
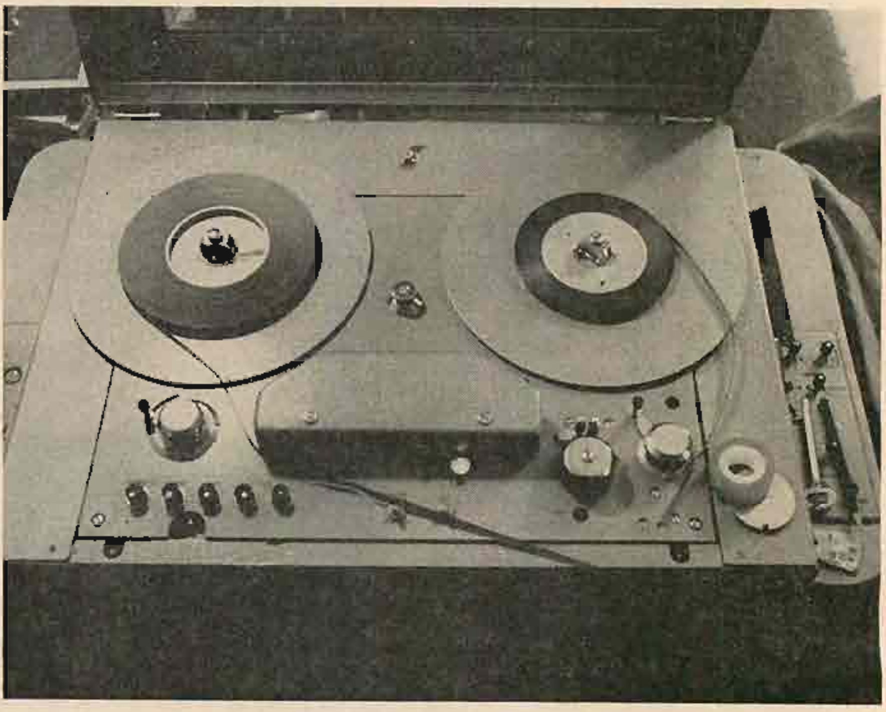


Mercury recording truck in Red Square. Engineer C. Robert Fine talking with Soviet traffic officer.



Closeup of U.S.S.R.-made tape recorder.

AUDIO ETC

(from page 14)

hi fi. And they happen every day. Even the unbalanced ones, as he says, can sound pretty good.

I suppose I should add, at this point, that my own preferred "listening seat" in recent months has been far off on one side, more or less on a line with my left-hand speaker. Not because I find the music better at that point, but because it happens to be convenient to sit there and I find the music virtually as good, balance or no. After all, don't people sit to one side of concert halls and theatres? And in a concert hall, remember, there isn't any balance control to help you adjust. In my lefthand listening seat I do, occasionally, throw the balance control over to the right a bit, to make the more distant speaker somewhat louder. But half the time I don't bother. I find that stereo, the real, imaginative, living thing, is too big, what with Beethoven and Bach and Bop—I mean Twist (or do I?) to be much bothered by a bit of literal unbalance. The thing to do is to sit back and listen, putting all thoughts of balance, of highs and lows and middles, well out of mind. If you must twiddle (and you must, of course), ration your time when it comes to adjusting and correcting. Your peace of mind can stand only so much of it.

If you haven't been able to balance a record by the time it is halfway through, I suggest two alternatives. Forget about balance, but quick. Or turn it off and try again another day.

COMPANDING

Some time 'way back last winter, the Fairchild people introduced the Model 510 Compander and sent me one with the suggestion that I play with it. I did—but not until some months later. I kept putting it off because this gadget is designed to alter your stereo sound in a fundamental way by dynamic expansion or, if you want it, compression. I knew this was a tricky business. Dynamic alteration of the sound signal—that is, continuously variable control of the signal *by the signal itself*—is full of pitfalls and complexities when applied to that subtle art we call music. The last time I had any intimate experience with a dynamic system was eons ago, the Dynamic Noise Suppressor back in the old 78 days kept me in business for months, in this department, and showed me how very little I knew then about audio, into the bargain.

Well, I know somewhat more now than I did then, but I am not very sure how the Fairchild Compander works. I think I can box it in fairly precisely for you, even so. It *does* work—first of all. Most of the problems inherent in any sort of feedback-like control have been neatly vanquished in this ingenious circuit. I could not make it misbehave in any obvious way. It does provide variable, adjustable dynamic expansion of loud passages in your music with a minimum of undesirable side-effects. (Also compression, as I say, but let that important function pass for the moment.) There is no added distortion, in theory and, as far as I could tell, in practice. The effect, even at maximum (something over 6 db) is relatively unobtrusive, as it would have to be for proper listening. There is no swish, no time-delay, no sudden whoosh of increased sound. Time delay does not seem to be an

THESE

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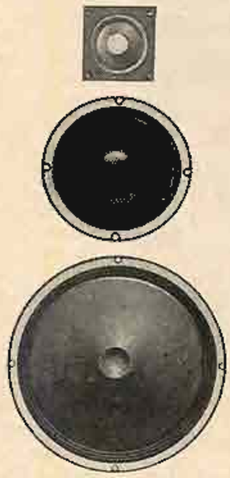
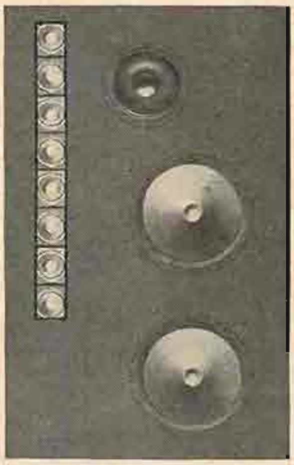
SPEAKERS



IN THIS ARRAY



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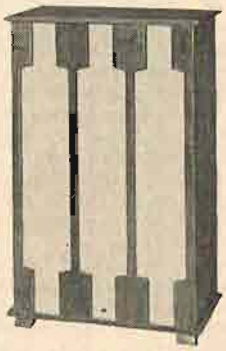

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audible factor and, if I guess right, is inherently not involved for the ear. Not in this circuit. (Actual figure: 10 millisec.)

I have heard too many compression and expansion devices, both in the phonograph field and in broadcasting, not to be on the alert for delay factors that often are highly audible—from the reverse-swish of compression that accompanies a baseball commentator on the air (the background suddenly goes down as he talks, then swishes back up again) to the unlovely carrumphs that used to be broadcast in the name of percussion—whether from bandit guns or Beethoven tympani.

Any device that introduces expansion or compression into serious music must be absolutely foolproof in this respect. Absolutely no audible swoosh or stumble or whatever you may call it. Even the early Dynamic Noise Suppressor, which was a useful gadget designed to help in a bad situation—hi-fi needle scratch and rumble from the 78 records and players—could produce some strange swishes and thumps when it was wrongly adjusted. (Its main function was to cut down the highs and the scratch, opening up when a loud high signal came along; similarly, it cut the bass upwards when there was no bass signal.)

The Fairchild Compander has no tubes—it is strictly a passive circuit. It makes use of a "sensing device," taking signal from the speaker lines to control the input gain—it can be placed either before the preamp, in the phono pickup line, or after it between preamp and power amplifier. The low impedance into the sensor is 16 ohms. Signal goes in at high or very high impedance and comes out ready to be amplified. Transformers somewhere in there, I presume. Whatever happens, happens virtually instantaneously. No audible delay, even with sharp sounds like piano tones. The volume expansion is very nearly perfect.

Some of the power that goes into the device is used to fire off a set of flashing indicators, two for each channel. Doesn't take much and they produce a surprisingly bright light, much flashier than a lot of tape recorder indicators I remember having seen. These lights tell the story, for each channel, and allow you to set your expansion (or contraction) thresholds. The Compander action begins when the lights fire off. If they are on all the time, you are expanding all the time and have merely added 6 db to your gain. So you adjust until they fire off only for the louder parts of the music.

It was here that I ran into the only complexity in the Compander operation. It is not to easy to figure out just what setting of the two controls (separate, for each channel) is best for the music. Indeed, the situation is inherently different for every record, depending on the music itself. In theory, you are "restoring" the volume range that was compressed in the original—if it was compressed. Sometimes it was, sometimes it wasn't. Not all music sounds like Richard Wagner. A great deal of music is easily recorded without volume compression of any sort. With quieter surfaces these days, LP records can be cut to very low levels, thereby increasing the effective dynamic range.

Moreover, while a great deal of music benefits from expansion (granted that you are in an expansive listening mood), much music simply does not gain in impact and may even lose effectiveness. It is not a universal rule that in the peculiar circumstances of home musical reproduction all music must sound "like the original." It seldom does, and rightly, for the home is not a concert hall nor is a recording a live performance.

So, you see, the Compander gives its operator some useful food for thought—and that is all to the good. I found, between thoughts, that I tended to leave the thing connected, even so. After a few days, I discovered that when it was turned off, I automatically turned turned it on again. Even without exact threshold adjustment, the Compander action is gentle and not unpleasant. Good. On the other hand, for careful listening I did find that each record had to be considered on its own merits and a readjustment at least attempted, for best effect. Moreover, as I had the Compander hooked up, there was one real inconvenience: When the main volume control is turned, the Compander threshold changes with it. Thus each time the over-all volume was adjusted, each channel on the Compander had to be re-set. If the Compander is inserted before the volume control, of course, this trouble is avoided—but then it usually will work only on one input circuit. Unless you tap into your switching system at a point before the volume control but after the junction of radio, phono, and so on. If you can do this, you'll get the best out of the Compander with the least inconvenience.

The expander circuit affords 6 db increase at maximum, but when the Compander is flipped to compression, the available total is some 20 db. The stated usefulness of this is for background music and such—to take the annoying foreground "presence" out of music which you don't want to listen to very hard. This, of course, is sheer mayhem, committed upon composers whose every intention was to place themselves in the foreground of your consciousness. But it might be justified, I suppose, on the grounds of present-day custom. However, I feel that a much more important use for the Compander compression is in connection with "live" home tape recording.

There is no greater problem, nor a more insoluble one, than the maintaining of acceptable dynamic range in a non-professional recording, particularly when (a) there is no rehearsal or preview, and (b) the performers do not know mike technique. Or choose to ignore your mikes in favor of their live audience, and/or other and more important mikes. (Many a "live" stage show in the jazz and folk music fields is recorded by dozens of microphones, some of which are professional and others strictly amateur. The performers are more or less obliged to favor some mikes at the expense of others.)

The problem of levels is made far more serious by stereo—or two-channel recording of any sort. If you move either volume control without moving the other, your balance jumps sidewise, but amateur talent has a disconcerting way of walking up to *one mike* and crooning into it à la Frankie, prewar. The idea that one should perform somewhere *between* two mikes just hasn't caught on yet. Even if you ignore stereo (a wise idea) and concentrate on the real joys of simple two-channel recording, you are bound to run into unexpected and violent overloads or underloads. Too few home two-channel recorders have the master level control that allows you to adjust both channels together with one knob. With separate controls you seldom guess right—one always moves further than the other and your balance is as steady as a ship at sea in heavy weather.

Aside from sixth sense and long experience, the answer is the Compander. With 20 db of compression available, you can set your two channels high enough to get the faint sounds with a minimum expectation of sudden overloading. No more hideous blasts—or not many. No more dismally faint recordings, lost down somewhere in the tape hiss. A maximum of signal and a minimum of noise. I didn't have a chance to try this out before I took off for the continent last summer but I am all eagerness to try, as soon as a chance presents itself.

YOU NAME IT

I can't resist throwing in one more "etc." item from my trip to Europe last summer—strictly non-audio, though, to be sure, I will force a sort of connection. It's all about trade names.

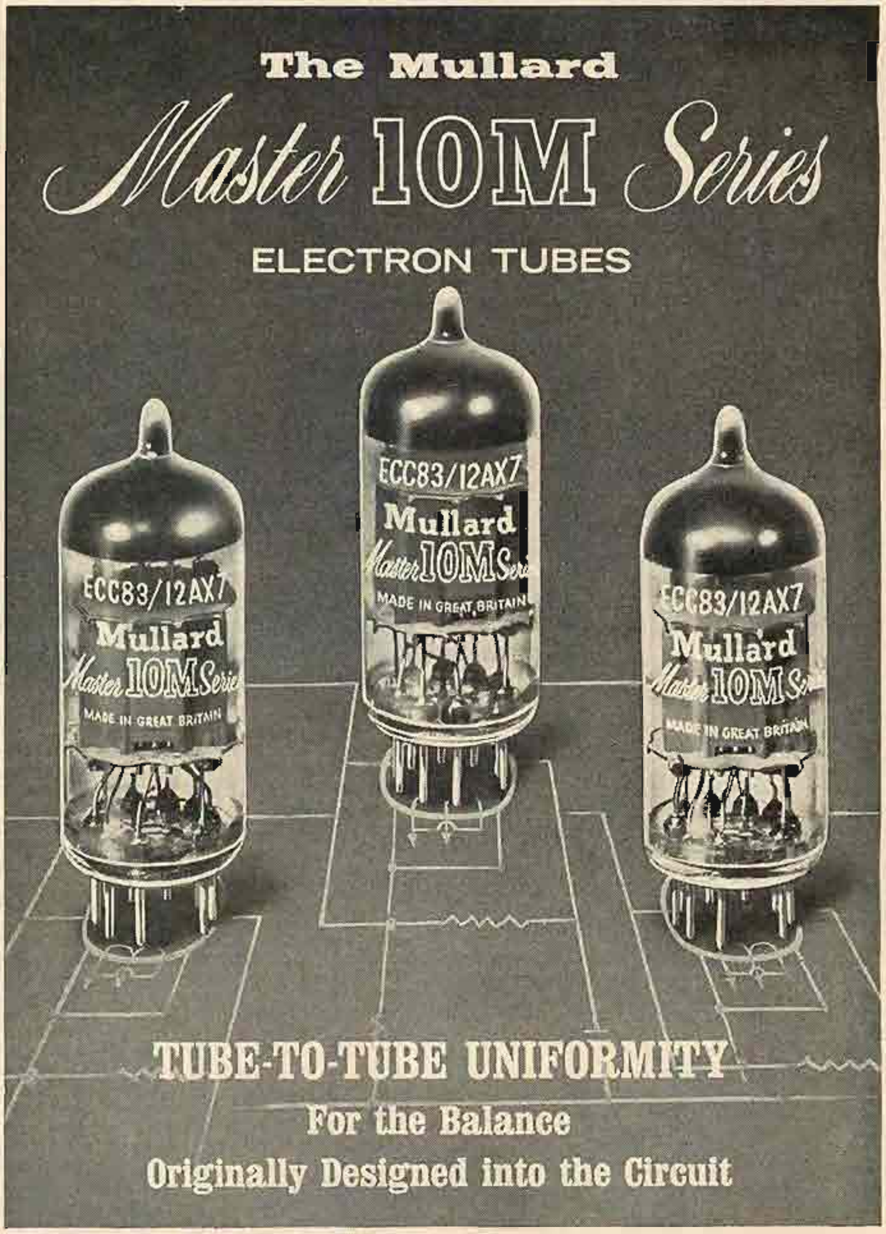
In the audio field, trade names are mostly polysyllabic, as befits the dignified technicality of the hi-fi component. (Or the pro audio component.) We ring the changes on Superthis and Stereothat, or Dyna-something and Sonic-something else. Dynaural, Stereosonic, Studiomatic, our titles are devised to have rhythm and weight. Nobody has ever put out an amplifier called the Flip, though to be sure, there is the Quad. Nor a cartridge called the Plink or the Zip. I've always enjoyed Paul Klipsch's minor inspiration, the speaker called the "Heresy" (it *wasn't* in a corner); but that was sort of special. So was the "Gigolo," presumably a handsome little speaker for the ladies. Generally speaking, though, we choose our trade names with great care and exactitude, according to the standards we have collectively set up for such things. We go for short names only in one area—initials. KLH, AR, ESL, ADC. They are still polysyllabic.

It's the detergent field that goes in for the one-syllable trade name, of course. There, it is as the French say *de rigeur*. A rigorous necessity. There's *Lux* and *Whisk* and *Duz* and *Cheer* and dozens more—and don't you believe that those names are easy to come by. Every one is as carefully calculated as massed advertising brass can make it. Probably each was chosen from a couple of million suggestions, all one-syllable. They sound casual, but they ain't.

Cereal names, American style, have to end with—*ies*, Rice Crispies. New ones do, anyhow. In Europe, though, there must be a polysyllable effect. *Croustiriz* (Crusty-Rice). Or *Noix d'Avoine* (Oat Flakes). Not so the detergents—they too go in for one-syllable names. But so different! Just goes to show how delicate this name business is.

Lux, of course, is *Lux*—what else. (Lux and Cornflakes, Coca-Cola and Pepsi, travel the world 'round.) But another laundry detergent is called *Cerf*. Still another, that washes dishes and softens water, is called *Prill*. How many packages would that name sell in the A & P? Then there's one that has a real muscle-toughening name—*Vim*. All full of Wim and Wigor, as we used to say. No wonder—for it "adds hygiene to cleanliness"—i.e. it contains a disinfectant. Then there is a rash of two-syllable names. *Dixan, avec mousse freinée*—with braked suds. And my favorite, a good product and a nice name, *Sunil*—a sunny sort of name. It "adds éclat to whiteness" and, natch, is put out by the same company as *Vim*. The U.S. equivalent is Blue Cheer or something. And *Persil*, which to every housewife's confusion means also Parsley.

Some of these names, as you see them on the shelves, in the stores or at the kitchen sink, strike one as having a lot of *éclat*, but others have the sprightliness of a lump of lead. My favorite in that category will end this disquisition. It is a strong detergent liquid in a plastic bottle and it has a simple claim: it Cleans Everything. Its name, the floppiest yet, is, believe it or not, *Flupp*. Æ



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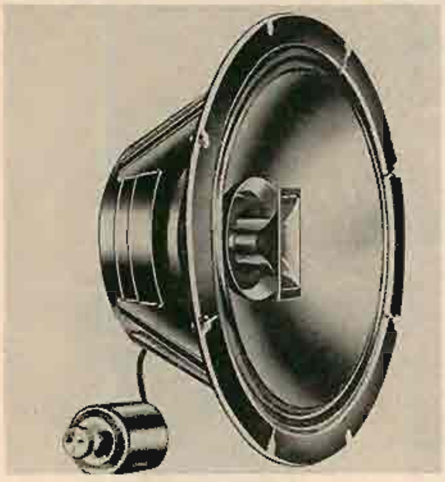
NEW PRODUCTS

• **Record-Playback Stereo Tape Deck.** The Model 6-44 is the newest in the Tandberg Six Series, 3-speed, 4-track, stereo record-playback tape decks. The Model 6-44 incorporates the same basic design and electronics of the Series 6 unit but includes such features as: a specially designed FM-MX filter input for direct recording of multiplex stereocasts; "free" position switch for independent turntable action permitting simple, easy tape loading and threading; completely automatic micro-switch tape stop; and other developments that fulfill all U.L. requirements. The Model 6-44 is available with four-track heads or as Model 6-22 (two track heads) and offers the following specifications: Frequency response—7½ ips ± 2db 30 to 16,000 cps; 3¾ ips ± 2db 40 to 11,000 cps; 1⅞ ips ± 2db 50 to 5500 cps. Flutter and wow: 0.1% rms at 7½ ips; 0.2% rms at 3¾ ips; 0.25% rms at 1⅞ ips. Signal-to-noise ratio at least 55 db. Heads: 3 precisely gapped heads. Operating controls: Push-button control with individual recording controls for each channel. List price is $498 for the unit complete with cables and empty reel. Remote control "F" Model which includes extra built-in solenoids and foot pedal lists at $548. Tandberg of America, Inc., Pelham, N. Y. **L-1**

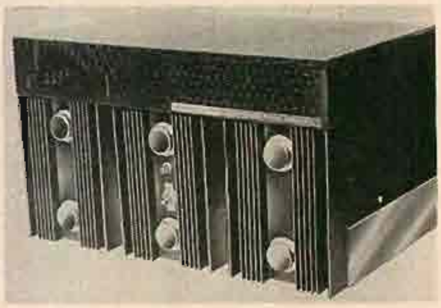
• **3-Way 15-in. Speaker.** Custom built in England to Lafayette's specifications, the SK-215WX features a massive 5-lb. ceramic magnet. The three elements—woofer, mid-range radiator, compression tweeter—are axially mounted for smooth wide-range performance. The woofer section has a cone resonance of 25 cps and features a plastic terminated, free-edge cone suspension. Specifications: Over-all frequency range, 20–20,000 cps; magnetic flux density, over 250,000 Maxwells; cross-over frequencies, mechanical at 2000 cps —12-db-per-octave LC at 5000 cps; power handling capacity, 50 watts; woofer voice coil diameter, 3-in.; tweeter voice coil diameter, 1-in.; impedance, 16 ohms. Dimensions: 8½-in. over-all depth; 15¼-in. diameter. Shpg. wt., 30 lbs. Price $64.50. Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, L. I., N. Y. **L-2**



• **Automatic Attenuator.** Fairchild Recording Equipment introduces the Model 661 "Auto-Ten," an automatic attenuator. A completely new approach to level control problems in PA and mixing techniques in film and record recording, the 661 automatically attenuates all information below the operator-selected threshold level. The device radically improves separation in multiple microphone recording; minimizes feedback in PA; allows efficient two-way conversations without relays and without feed-back; reduces "breathing" in compressors and limiters, and many other uses. Fast attack time and variable release time allows great flexibility. Will not introduce distortion and is not frequency-discriminating. Works in circuits from 50 ohms to 50,000 ohms and handles levels from −35 dbm to +25 dbm. Fairchild Recording Equipment Corp., 10-40 45th Ave., L. I. C. 1, N. Y. **L-3**

• **Thin Speaker System.** Only four inches in depth, but with the response characteristics of full-size speaker systems, the University Syl-O-Ette is claimed to be the only ultra-thin system that is free from the distortion problems inherent in ultra-thin enclosures. The Syl-O-Ette is designed to be as beautiful to behold as it is to hear. It has a three-dimensional art-frame cabinet of walnut veneers, and a selection of grille fabrics: hand-embroidered petit point grilles imported from the island of Madeira, silk-screened, neo-classic art grilles as well as decorator cane grilles . . . thus making the Syl-O-Ette suitable for any decor, any period. And by means of special hardware and easily removable base, it may be used on the floor or wall, horizontally or vertically. Price of the Syl-O-Ette is $99.95 or $109.90, depending on grille. University Loudspeakers, 80 South Kensico Ave., White Plains, N. Y. **L-4**

• **200-Watt All-Transistor Stereo Power Amplifier.** The new Lafayette LA-280WX 200-watt all-transistor stereo power amplifier uses a total of 30 solid-state devices (15 power transistors and 14 silicon rectifiers). The LA-280WX develops 100-watts music power in each stereo channel into a 4-ohm load, 58 watts each channel into an 8-ohm load, 33 watts each channel into a 16-ohm load. Heart of the amplifier is its unique Class-B operated bootstrap output circuitry with 70 db of feedback and employing two transistors in each half of the output circut (only one is used in conventional units). Frequency response is ± 0.1 db from 15 to 20,000 cps; −3 db at 80,000 cps minimum. Harmonic distortion is less than 0.1 per cent; intermodulation distortion is less than 0.2 per cent. Overload recovery time: 50 microseconds maximum. Channel separation: 68 db minimum at 2000 cps; 54 db minimum from 15 cps to 20,000 cps. Controls include power on-off and gain (level for each channel). It may be used with either transistor or vacuum-tube preamplifiers; two high-level and two low-level preamp inputs are provided. Also provided are screw-type speaker terminals, stereo headphone jacks, and four a.c. outlets. Size: 18" × 8" × 8". Shipping weight, 35 lbs. Net price, $299.50. Lafayette Radio Electronics Corporation, 111 Jericho Turnpike, Syosset, L. I., New York. **L-5**



• **Stereo Phonograph.** A new portable phonograph, the Model Eleven, has just been unveiled by KLH. The Model Eleven speakers feature a new design and construction. Its transistorized dual amplifier delivers 15 watts peak on each stereo channel. A Pickering magnetic pickup with diamond stylus is used in a Garrard AT-6 record changer. The components are mounted in an attractive and rugged carrying case of vinyl-clad "Contourlite," a new fibrous plastic matrix, combining extreme lightness and impact strength. The Model Eleven weighs a mere 26 pounds. Because of the care with which the entire instrument is constructed, the KLH Model Eleven carries a five-year guarantee—offering free repairs for the first two years, and any repair thereafter for $12, including both parts and labor. The price is slightly under $200. KLH Research and Development Corp., 30 Cross St., Cambridge, Mass. **L-6**

• **Danish-Modern Cabinet.** A new authentic Danish-Modern cabinet ensemble to house stereo or mono high fidelity components has been introduced by Rockford Special Furniture Company. This new Model 700-701 Ensemble is decorator designed and acoustically engineered to provide a beautiful home music center at economical cost and enables utilization of separate, famous-name high fidelity components for finer mono or stereo reproduction. It combines a center equipment cabinet and twin free-standing speaker enclosures, which may be placed together or separate, as desired. The cabinets are furniture crafted of selected woods. In

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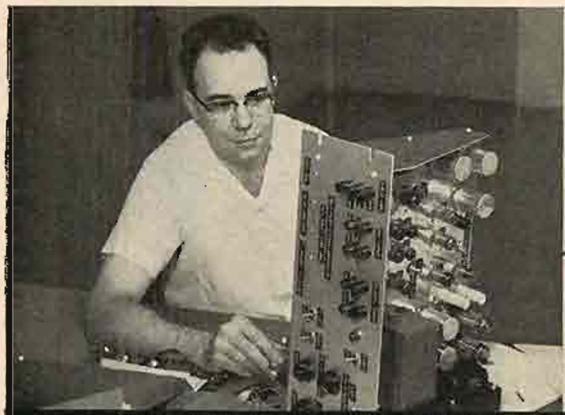
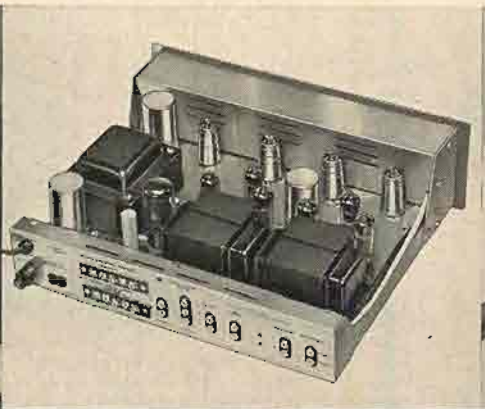
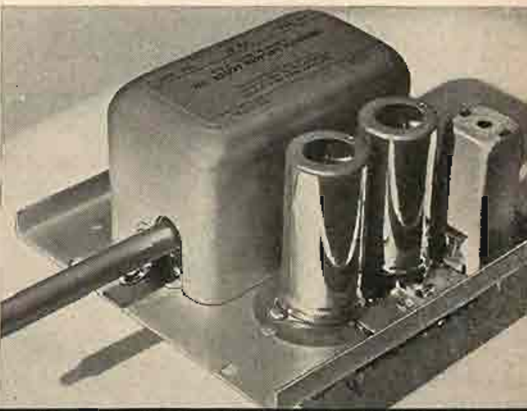


Advanced Engineering. Scott quality begins in the laboratory where the Advanced Development Team pioneered Wide-Band Design and "Time-Switching" multiplex circuitry. Chief Engineer Daniel Von Recklinghausen is shown here with the original model of the world's first commercial FM Stereo signal generator, which is used by manufacturers throughout the world.



Design Leadership. All Scott amplifiers use massive output transformers to assure full bass response to below 20 cps. Important engineering extras such as solid aluminum chassis and DC heated preamplifier tubes assure performance that is totally free from hum and noise.



Uncompromising Quality Standards. The heavily silver-plated RF section and the Wide-Band circuitry common to all Scott tuners is shown here. These exclusive design features result in high sensitivity without distortion, complete freedom from drift, and outstanding reception even from weak multiplex stations.

Conservative Claims. Every Scott component is guaranteed to meet or exceed claimed specifications. Each component undergoes more than fifty separate tests. Scott uses IHFM test procedures to guarantee that you receive meaningful specifications. Shown here is the elaborate "screen room" used for precision alignment of tuners.

Technical Recognition. WCRB, Boston's leading good music station, uses Scott multiplex equipment for monitoring and for long-distance relay of their FM stereo broadcasts. The reliability, high sensitivity, and rugged construction of Scott tuners and amplifiers make them the choice of more than 100 leading FM stations.

Musical Recognition. Professional musicians, like these members of Boston's leading symphony orchestra, choose Scott components for their own music systems. The expert editors of America's most respected high fidelity magazines consistently give Scott components top ratings, and highly recommend them to their readers.

Scott components, like the 80-Watt 299C shown here, are designed with useful, years-ahead features including separate bass and treble controls; derived center channel output with front panel control; complete tape monitoring facilities and Scott's exclusive stereo-balancing circuitry. Your franchised Scott dealer will be proud to demonstrate Scott tuners, amplifiers and speakers for you without obligation.

FREE! New Stereo Record "The Sounds of FM Stereo"

Scott has just produced a new 7" stereo record demonstrating FM Stereo and explaining the meaning of the technical specifications used to describe this wonderful new kind of broadcasting. For a free copy, and Scott's new 20 page "Guide to Custom Stereo" mail this coupon today.

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unidirectional
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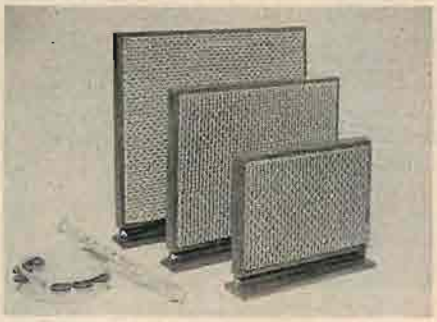
Most low cost microphones pick up sound indiscriminately—from all around the room . . . the result is tapes with too much "room echo" and ambient noise. Unidirectional microphones (which pick up sound mainly from the front while suppressing unwanted sound coming from the sides and rear) were too high priced for many users. Now! Shure has incorporated its world-famous "Uniphase" network (found in our most expensive unidirectional dynamic microphones) into this low cost, probe-type ceramic microphone that makes it possible for you to get professional results at a minimum investment. Ask for a demonstration at your microphone or sound system dealer's . . . you'll hear how it can improve all your tapes . . . especially stereo!

50 to 7000 cps response. Can be hand held, or stand mounted. Response at rear down 15db from front. High impedance.

Literature:
SHURE BROTHERS' INC.
222 Hartrey Ave.
Evanston, Ill., Dept. 44-A

the Model 700 Center Equipment Cabinet, the upper right compartment, with lift top, is designed for all record changers, most transcription tables or tape recorders; the lower right compartment has space for 100 12" records; the upper left compartment is designed to house amplifier and/or preamplifier, or tuner. It has a removable shelf which is adjustable in height. It also has a blank face-panel for custom installation of components without cases. The lower left compartment may be used for additional record space, tape storage, books or decorative display. Hinged doors, with magnetic latches, are used for easy access. Over-all size of the equipment cabinet: 38¼" wide, 28¼" high, 17¾" deep. The Model 701 matched twin speaker enclosures each house up to a 12" loudspeaker. Over-all size of each speaker enclosure: 17" wide, 28¼" high, 17¾" deep. The individual cabinets in this ensemble are also available separately. Rockford Special Furniture Co., 1803 W. Belle Plaine, Chicago 13, Illinois. **L-7**

• **Ultra-Thin Speaker Systems.** Advanced Acoustics introduces three new ultra-thin high fidelity loudspeaker units in their Bi-Phonic coupler series. The new units which are designated as Planar types are only 1⅝-in. in width and substantially smaller in size than previous or conventional types. Planar units use a plane section which vibrates as a single element. A new type of compression tweeter is used in conjunction with the vibrating panel. Response is claimed to be substantially flat from 35 cps to well beyond the audible range. These units are completely unbaffled with free unrestricted radiation on both sides, so that the radiation pattern is a double figure-8. The three new units in the series include the two-way Bi-Planar unit Model BP15, the three-way Tri-Planar Model TP15 which incorporates a mid-range coupler, and the Model QP40 Quadra-Planar which incorporates a double bass Bi-Phonic coupler, as well as 4 double mid-range and high-frequency sections. The dimensions of the three speakers are 1⅝"×12"×15", 1⅝"×15"×23", and 1⅝"×20"×24" respectively, which permits the units to be hung on a wall like a picture, incorporated into a furniture piece or book shelf, used as a room divider, or even hidden behind draperies or wall decorations. The Models BP15 and TP15 are capable of handling peak audio power up to 15 watts and 30 watts respectively and the Model QP40 can handle power up to 50 watts. Impedance is 8 ohms. Prices for the three units are respectively $49.00, $69.00, and $135.00, with matched pairs for stereo reproduction at a somewhat lower cost. Advanced Acoustics Co., 67 Factory Place, Cedar Grove, New Jersey. **L-8**



• **Stereo Tape Recorder.** Imported from Norway, the new Proton Magnetofon 4-track recorder Model 94, is said to be highly rated by European stereofans as one of the top-quality popularly-priced European recorders. The Proton records and plays 4-track stereo and mono; plays 2-track stereo and mono; has dual 4.5-watt stereo amplifiers (9 watts mono); dual stereo "magic eye;" exclusive "Programindikator"; two-channel balance control; bass control; edit control. Specifications: Two speeds—7½ and 3¾ ips; frequency response—30–15,000 cps ±2 db at 7½ ips, 40–9000 cps ±2 db at 3¾ ips; signal-to-noise ratio is better than 50 db. Flutter and wow are less than 0.12 per cent at 7½ ips; hysteresis-synchronous motor. Imported by American Foreign Industries, Inc., 640 Sacramento St., San Francisco 11, Calif. **L-9**

• **"Large" Loudspeaker Systems.** Providing excellent sound reproduction as well as implementing the noticeable return to large loudspeaker systems for those homes that are in themselves sufficiently large to accommodate them without disturbing the decorating scheme, two Altec models have undergone minor changes to make them still better than before.

Model 838A, the "Carmel," stands 29¾ in. high, is 35 in. wide, and 17¾ in. deep, standing on the optional decorator base shown. The standard model comes with round legs. Electrically, the Carmel is equipped with two 414A high-compliance woofers, covering the range from 30 to 800 cps, and the high-frequency range to 22,000 cps is covered by a model 804A driver coupled to an 811B sectoral horn. The dividing network is of the constant-resistance type crossing over at 800 cps. An external control on the back panel enables the user to adjust for room acoustics and liveness.

Identical in appearance is the 837A "Avalon," which is equipped with the same high-frequency driver and horn, but with only one 414A woofer. Both models are available in walnut or mahogany. Altec Lansing Corporation, 1515 South Manchester Ave., Anaheim, California. **L-10**

NEW LITERATURE

• **Kit-Builders Guide.** H. H. Scott has just released a new edition of their complete Guide to Kit Building. This color brochure shows the complete line of Scott Kits and tells how to select the right kit for your needs. A free copy of this brochure is available by writing to H. H. Scott, Inc., Department P, 111 Powdermill Road, Maynard, Mass. **L-11**

• **Sound-to-Slides Booklet.** The Mark-Q-Matic Division of General Techniques, Inc. has released a new booklet which illustrates a new technique for adding sound to 35mm slides. The new method uses a pencil mark less than a ½" wide on the oxide face of the recording tape to actuate the change mechanism in an automatic slide or film strip projector. The pencil mark, which is called a "cue-point," can easily be erased. And, because it is visible, numbers, letters or symbols can be used as cue-points for easy identification. The booklet, entitled: "Make 'Talkies' Out of Your Slides," may be obtained free of charge by writing to the attention of Dept. R62, General Techniques, Inc., 1270 Broadway, New York 1, N. Y. **L-12**

• **Miniature Lamp Catalog.** A new 12-page catalog featuring specifications for miniature or sub-miniature incandescent lamps is announced by Hudson Lamp Company. Greatly expanded and improved over previous catalogs, it serves as a complete reference source useful to engineers, designers, buyers, and production personnel. It features actual size-dimensioned illustrations of all lamp styles, and, for the first time in published material, shows candle power values for all types. New listings include automotive heavy duty lamps, and an expanded line of sub-miniature lamps, including the recently announced Tu-Pin types. There are also sections on lamp terminology and miniature lamp selection. For a free copy write on your letterhead to Hudson Lamp Company, 528 Elm Street, Kearny, N. J. **L-13**

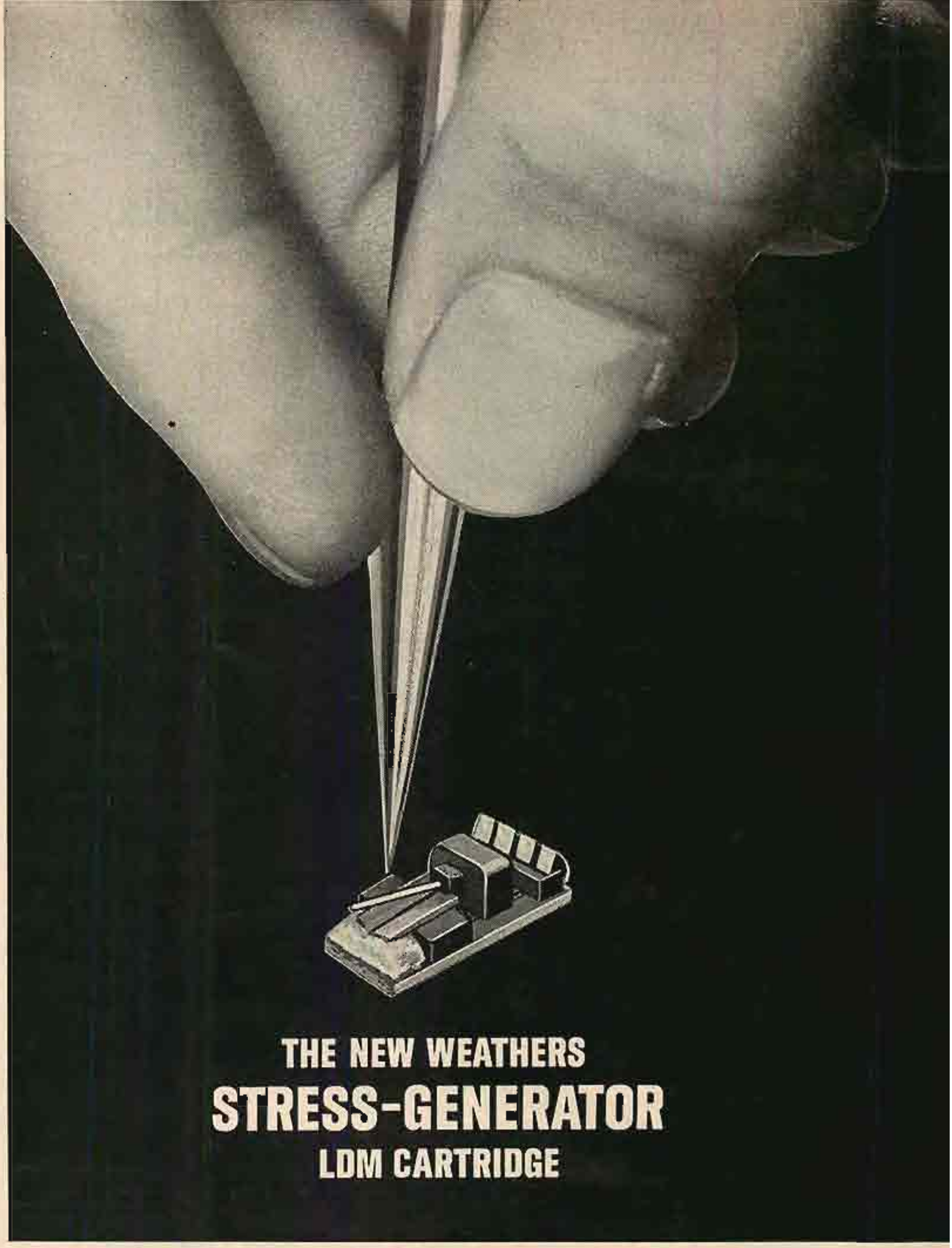
• **Shure Catalog.** A new catalog, exclusively devoted to Shure high-fidelity products, has been announced by Shure Brothers, Inc., Evanston, Illinois. Described in the eight-page booklet is their complete line of monophonic and stereo Dynetic phonograph cartridges, including the new M33 and M77 models. The catalog also describes tone arms and the company's line of stereo preamplifiers. In addition to an illustration of each unit, the catalog lists complete technical specifications and prices. Copies of the Shure High Fidelity Products Catalog are available at no cost from Sales Dept., Shure Brothers, Inc., 222 Hartley Avenue, Evanston, Ill. **L-14**

• **Users Guide.** "High Fidelity Systems: A User's Guide," by Roy F. Allison. Published by Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass. 70 pages paper. Price: $1.00, postpaid, direct from publisher only.

This is a guide for the layman on setting up and caring for high-fidelity sound systems in his home. Simple English is used; the author addresses people with no technical or hobbyist background.

A brief introduction describes the parts, or components, of both mono and stereo systems. Readers are given useful shopping information, and this is followed by simple but detailed instructions for installing, interconnecting, and adjusting the components for best results. Finally, there are suggestions on the proper use and care of stereo systems, and advice on what to do in case of trouble. Drawings and photographs are used liberally throughout the book.

Although the book is published by Acoustic Research, a manufacturer of speakers and turntables, it contains no advertising material. Examples of components used for the illustrations are not limited to AR products.



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The new Weathers LDM eliminates excessive mass with its unique stress-generator design...the same operating system utilized in the famous Weathers Professional Cartridge. There are no moving coils, no heavy magnetic materials, no drive-arm linkages. As a result, the LDM is the first cartridge that can freely respond to the most rapid groove motions, reproducing peak passages without break-up of the music. Conventional cartridges which operate on the basis of accelerating magnets, or coils, or ceramic elements may exert many tons per square inch during peak passages—thus literally crushing the delicate record groove engravings.

The LDM stylus assembly is attached to a mounting block which stresses the tiny transducing elements. As the stylus shifts position, the slight flexing of the mounting block is passed on to the transducing elements as a **stress force.** There is no measurable movement in the element, but the resulting stress causes the element to emit a voltage, which is a replica of the original recording. As a result, the Weathers LDM has ideal channel separation, even down to the lowest recorded frequencies (a major difficulty with most other cartridges). It is completely free of induced hum. It tracks perfectly at one gram, and its stylus retracts completely to avoid damage due to mishandling. Here in a cartridge of modest cost is the cleanest, most musical sound you've ever heard, completely free of break-up, regardless of output level. For the complete story on this remarkable new cartridge, write to Weathers Industries, Dept. AC-10, 50 West 44th St., New York 26, N.Y. Audiophile net price—$39.50.

Stylus: .7 mil radius diamond
.3 milligram tip mass
Output: 5 millivolts at
7 centimeters per second
Frequency Response: 20 to 20 k.c., ± 2 d.b.
Channel Separation: Exceeds 30 d.b.
Input: Matching networks (included)
to low level magnetic input
Mounting: Standard, hardware supplied

WEATHERS
Division of
TelePrompTer Corporation

W

T-12

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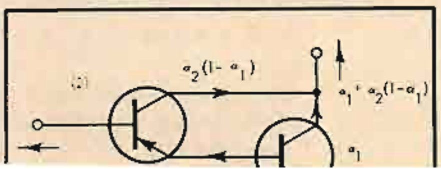
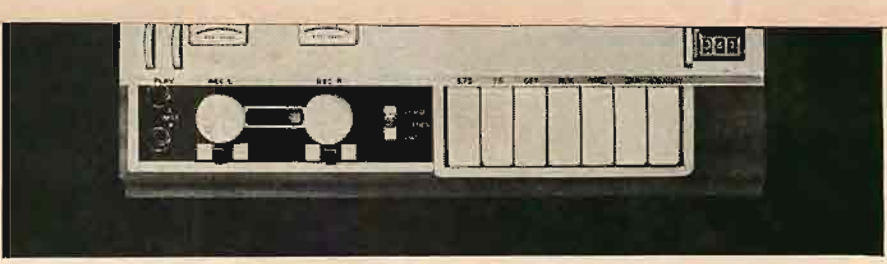
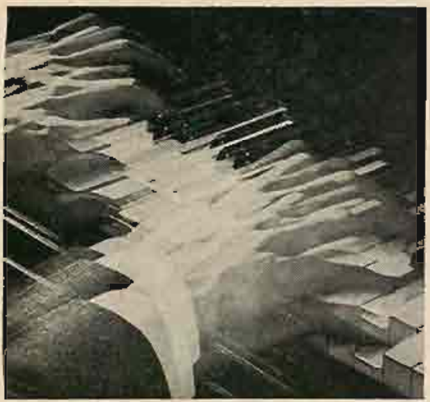
input impedance by looking at the input characteristics of the two transistors. As you can see, the base input impedance of the main transistor appears as an emitter feedback resistance in the circuit of the input transistor and helps to give the high input impedance we shall observe. Typically we may need 1–2 volts of drive and 1–2 ma of input current to get a 2-amp load current.

A full analysis of the frequency characteristic of the composite pair is rather





Three-motor professional-type drive provides you full control and safety for your tapes through all functions, at all speeds. Separate playback heads let you monitor off the tape to keep constant check of recorded program. Other features offer sound-on-sound, echo effect and amazing DUOSOUND . . . the feature that lets you re-record monaural records, tapes and broadcasts with thrilling stereo



to make the most of shaky acoustics . . .

AMPLIFIER

(from page 22)

Crowhurst in his book *"Audio Measurements,"* page 131. However, it is believed that if the shunt network is selected on the basis of the lowest frequency peak found that the effect of higher frequency resonances will not cause instability.

Higher power output may be obtained by increasing the plate and screen voltages of 5881 tubes to 400 and 300 respectively, with grid bias increased to about 25 volts. About 32.5 watts can be obtained from a pair of 5881's at these voltages.

Still higher power output can be obtained with 6L6GC and 7027 tubes as previously discussed or with EL34 and KT88 tubes.

One final note: Noise and hum have not been measured and recorded because

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Choice of push-pull 10-watt audio or output to your Hi-Fi system . . . D.C. restoration . . . Ultra-linear sweep circuits . . . Standard Coil New Automatic PKO Fine Tuner . . . Super-sensitivity for fringe areas . . . Complete line of Accessories for Custom Installations.

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less you are prepared to accept some other limitation at some other point in the circuit. This may pay off, but you do not get something for nothing, and indeed, as one of Damon Runyon's characters pointed out, "life is 5–3 against" (and the odds are I have the odds wrong). As far as I can see, however, the money to be saved by using transistors which will give trouble below about 10,000 cps is not very much when compared with the total cost of the system and there is no point in trying to pinch the last cent out of the cost when elsewhere much larger sums are uncertain.

A gleam of hope, or extra despair, for the real pedant comes when we use an output stage with a practical load, a loudspeaker. A single moving-coil speaker will have an impedance characteristic which rises at high frequencies and which will therefore produce a voltage step when we get the run-up of collector current shown in *Fig.* 5. This looks after the feedback circuit problem rather nicely, though it leaves me wondering if constant terminal voltage is, in fact, what we want. It is what our feedback circuits want, anyway.

An electrostatic tweeter, on the other hand, has just the wrong kind of impedance and will make the lot of the driver stage even harder. Thus an amplifier which is satisfactory on laboratory test with a resistive load may be good with an all moving-coil speaker system and bad with a partly electrostatic system. Good and bad are rather delicate terms, because we are talking only of intermodulation effects at the top end of the range at full load.

The moral, if there is one, is quite simply this. When you see a new arrangement of old parts which is claimed to have some special features, always take a close look to see what has been lost on the deal. Usually you will find that the difficulties have been moved to another part of the circuit and they may be easier to handle there, they may be harder. But they are there. And after all you can always emulate Whitman:

I wandered off by myself,
Looked up in perfect silence at the stars.

Æ

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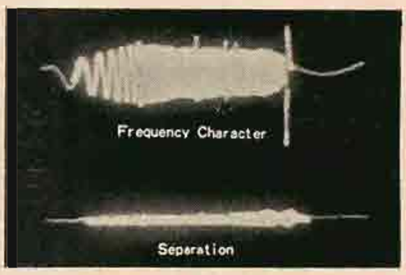

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NEW LITERATURE

• **Kit-Builders Guide.** H. H. Scott has just released a new edition of their complete Guide to Kit Building. This color brochure shows the complete line of Scott Kits and tells how to select the right kit for your needs. A free copy of this brochure is available by writing to H. H. Scott, Inc., Department P, 111 Powdermill Road, Maynard, Mass. **L-11**

• **Sound-to-Slides Booklet.** The Mark-Q-Matic Division of General Techniques, Inc. has released a new booklet which illustrates a new technique for adding sound to 35mm slides. The new method uses a pencil mark less than a ½" wide on the oxide face of the recording tape to actuate the change mechanism in an automatic slide or film strip projector. The pencil mark, which is called a "cue-point," can easily be erased. And, because it is visible, numbers, letters or symbols can be used as cue-points for easy identification. The booklet, entitled: "Make 'Talkies' Out of Your Slides," may be obtained free of charge by writing to the attention of Dept. R62, General Techniques, Inc., 1270 Broadway, New York 1, N. Y. **L-12**

• **Miniature Lamp Catalog.** A new 12-page catalog featuring specifications for miniature or sub-miniature incandescent lamps is announced by Hudson Lamp Company. Greatly expanded and improved over previous catalogs, it serves as a complete reference source useful to engineers, designers, buyers, and production personnel. It features actual size-dimensioned illustrations of all lamp styles, and, for the first time in published material, shows candle power values for all types. New listings include automotive heavy duty lamps, and an expanded line of sub-miniature lamps, including the recently announced Tu-Pin types. There are also sections on lamp terminology and miniature lamp selection. For a free copy write on your letterhead to Hudson Lamp Company, 528 Elm Street, Kearny, N. J. **L-13**

• **Shure Catalog.** A new catalog, exclusively devoted to Shure high-fidelity products, has been announced by Shure Brothers, Inc., Evanston, Illinois. Described in the eight-page booklet is their complete line of monophonic and stereo Dynetic phonograph cartridges, including the new M33 and M77 models. The catalog also describes tone arms and the company's line of stereo preamplifiers. In addition to an illustration of each unit, the catalog lists complete technical specifications and prices. Copies of the Shure High Fidelity Products Catalog are available at no cost from Sales Dept., Shure Brothers, Inc., 222 Hartley Avenue, Evanston, Ill. **L-14**

• **Users Guide.** "High Fidelity Systems: A User's Guide," by Roy F. Allison. Published by Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass. 70 pages paper. Price: $1.00, postpaid, direct from publisher only.

This is a guide for the layman on setting up and caring for high-fidelity sound systems in his home. Simple English is used; the author addresses people with no technical or hobbyist background.

A brief introduction describes the parts, or components, of both mono and stereo systems. Readers are given useful shopping information, and this is followed by simple but detailed instructions for installing, interconnecting, and adjusting the components for best results. Finally, there are suggestions on the proper use and care of stereo systems, and advice on what to do in case of trouble. Drawings and photographs are used liberally throughout the book.

Although the book is published by Acoustic Research, a manufacturer of speakers and turntables, it contains no advertising material. Examples of components used for the illustrations are not limited to AR products.

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Channel Separation: Exceeds 30 d.b.
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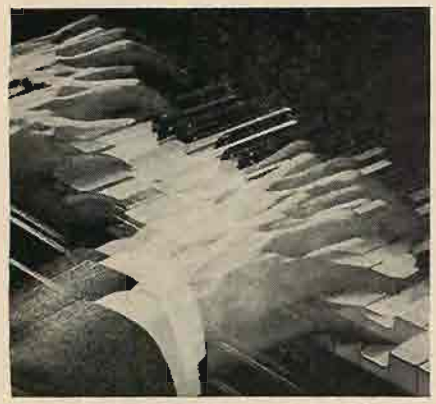

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CIRCLE 98A

AMPLIFIER

(from page 22)

Crowhurst in his book *"Audio Measurements,"* page 131. However, it is believed that if the shunt network is selected on the basis of the lowest frequency peak found that the effect of higher frequency resonances will not cause instability.

Higher power output may be obtained by increasing the plate and screen voltages of 5881 tubes to 400 and 300 respectively, with grid bias increased to about 25 volts. About 32.5 watts can be obtained from a pair of 5881's at these voltages.

Still higher power output can be obtained with 6L6GC and 7027 tubes as previously discussed or with EL34 and KT88 tubes.

One final note: Noise and hum have not been measured and recorded because there simply is no audible output from this amplifier at more than one foot from the loudspeaker unless a sound input is being fed into the amplifier. The author has been confused by power figures quoted on units as many, many db below some arbitrary level, when he has heard annoying him or noise from the equipment in question, and prefers the listening test.

Any persons writing to the author are requested to send self-addressed stamped envelopes to ensure receiving a prompt reply. Æ

CLAVICHORD

(from page 44)

instruments will then occupy a place barred to the conventional instruments instead of substituting for them as they now do. There are some patents already issued for electronic organs in just intonation.

The reintroduction of the just intonation into our culture will take time. Composers will write compositions for an instrument only if the instrument is sufficiently developed and musicians play it. The instrument will enter upon a period of development only if compositions are written for it and musicians play it. Musicians will learn the technique of playing it only if it is sufficiently developed and compositions are written for it. This loop will supply its own positive feedback if there is enough initial excitation. The method outlined here for working in the just intonation is intended to arouse a practical interest in the serious application of this intonation. Æ

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CIRCLE 98B

OUTPUT STAGE

(*from page 64*)

means a large voltage drive from the preceding stage and a conventional common-emitter stage gives us current drive instead of voltage drive.

Watch for the Cooper Compromise.

I hope that by now the reader is convinced that although, in Whitman's words, *"I beat and pound for the dead"* I also cry *"Vivas to those who have failed."* The interesting thing about this arrangement which Mr. Clark has brought to our notice is that in searching out its defects we come to think of the defects of other circuits. The popular circuit for output stages this season is based on the Darlington composite pair, in which a low-power-side band common-collector transistor drives the common-emitter output stage and also acts as a topping-up stage. The usual way of analyzing the composite circuit (and analyze it we must, for the limitations which we have found in the other circuits have raised doubts about the composite circuit) the usual way is to start with the emitter current of the main transistor and call this unity.

The build-up of the analysis was done in drawing *Fig.* 6. If the emitter current of transistor (1) is 1, the collector current is α_1 and the base current is $(1-\alpha_1)$. This base current is the emitter current of transistor (2) which therefore has a collector current of $\alpha_2(1-\alpha_1)$ and a base current of $(1-\alpha_2)(1-\alpha_1)$. The total current passed by the two collectors is $\alpha_1+\alpha_2(1-\alpha_1)$ or $\alpha_1+\alpha_2-\alpha_1\alpha_2$, and the over-all current gain is very close to $1/[(1-\alpha_1)(1-\alpha_2)]$ so long as α_1 *and* α_2 are near unity. We think nothing of current gains of the order of 1000.

In practical design work we get the input impedance by looking at the input characteristics of the two transistors. As you can see, the base input impedance of the main transistor appears as an emitter feedback resistance in the circuit of the input transistor and helps to give the high input impedance we shall observe. Typically we may need 1–2 volts of drive and 1–2 ma of input current to get a 2-amp load current.

A full analysis of the frequency characteristic of the composite pair is rather complex because of the effect of internal feedback through the transistors. We can, however, get a fairly good idea of what is likely to happen when we apply a steep-front step voltage to the base of the driver transistor. The main transistor can be considered as an idle diode for the period during which the holes are diffusing towards the collector junction. The main feedback loop, we must assume, is sending back the message that it requires a particular current in the pair and is allowing enough drive to reach the input base to produce this current. The driver transistor will be forced to try to deliver this current.

We can see this in another way. In the absence of a collector current in the main transistor, the voltage developed at the base is the product of the base-emitter diode resistance and the base current. When the driver has a high transconductance we expect that this main transistor input voltage will be almost equal to the input voltage. Again we see that we are calling for a very high driver current.

You see the general principle which we have reached: if it takes τ microseconds for the news to get through from the input electrodes to the collector there is nothing to be done about it un-

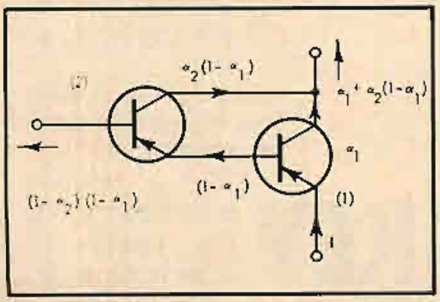

Fig. 6. The behavior of the pair is revealed by the current relationships.

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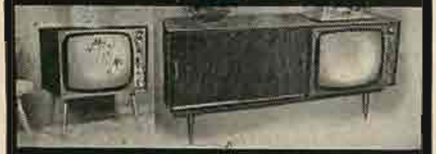

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CIRCLE 100A

less you are prepared to accept some other limitation at some other point in the circuit. This may pay off, but you do not get something for nothing, and indeed, as one of Damon Runyon's characters pointed out, "life is 5–3 against" (and the odds are I have the odds wrong). As far as I can see, however, the money to be saved by using transistors which will give trouble below about 10,000 cps is not very much when compared with the total cost of the system and there is no point in trying to pinch the last cent out of the cost when elsewhere much larger sums are uncertain.

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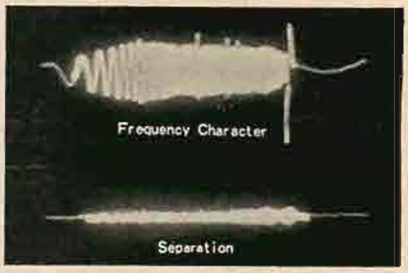

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CAPACITOR MICROPHONE MIXER

(*from page 54*)

reason that the current requirements are listed on the schematic rather than indicating the specific part. Although a suitable transformer may be readily available for this design, I did not find one in my personal listings. Any suitable choke over 5 henry may be used as long as the total d.c. resistance in the filter circuit does not exceed 180 ohms. An example of a filter circuit using standard components is shown in *Fig.* 11.

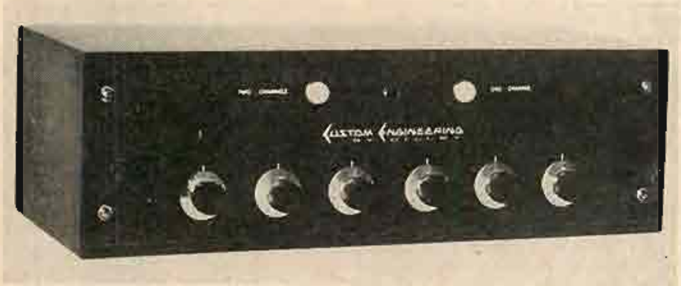

Fig. 13. Front view of final layout.

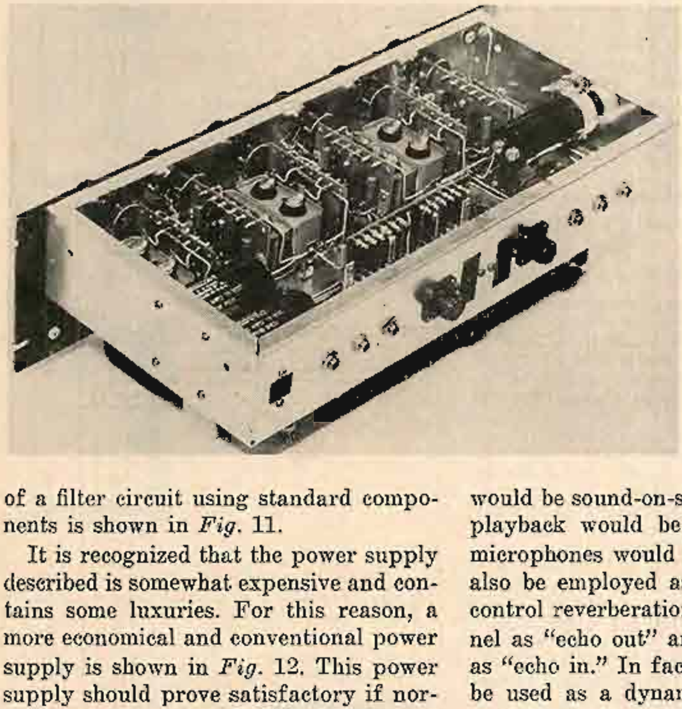

Fig. 14. Underchassis view.

It is recognized that the power supply described is somewhat expensive and contains some luxuries. For this reason, a more economical and conventional power supply is shown in *Fig.* 12. This power supply should prove satisfactory if normal care is exercised with heater and lead dress. There should be no need for d.c. heater voltage for successful performance, but the mixer plate circuit must be manually switched since most relays will induce hum in the plate circuit when the coil is energized by an a.c. voltage.

Applications

As stated in the design considerations, one of the main objectives was to obtain flexibility, or more simply, to obtain a multi-purpose unit. In practice, this amplifier satisfies this requirement. It can be used with six condenser microphones for initial recording, or with a lesser number of microphones plus other high-level sources.

In the following re-recording process it can be used as a line amplifier-mixer to mix either voice or music from microphones, or other high-level sources with the original tape playback. An example would be sound-on-sound, where the tape playback would be high level and the microphones would be low level. It may also be employed as a line amplifier to control reverberation by using one channel as "echo out" and the other channel as "echo in." In fact, in a pinch, it may be used as a dynamic microphone preamp for mono recording by plugging the output of one channel into one of the inputs of the other channel and controlling the gain from the second channel. If the levels of the mikes can be controlled by placement alone, three dynamic microphones can be used in this manner.

The sound reenforcing application is obvious, since a one-volt output will drive almost any amplifier to full power.

In short, for the small studio or enthusiast employing condenser microphones, and desiring the maximum of capability with the minimum of equipment, this mixer offers an economical solution. Æ

The Pro's Nest

Saul J. White
Chief Engr., Audio Products,
Rek-O-Kut Co.

No. 10 "WHAT PRICE EFFICIENCY?"

It's good to be back, and many thanks to the half hundred readers who have written to me and to the editor. This will continue to be a column of personal journalism aimed at raising both my ego and the standards of the audio industry without censorship from any quarter. LET'S TALK ABOUT EFFICIENCY.

When you buy a 100-watt light bulb you do not expect the illumination of a candle flame. In every field of technology we strive for efficiency. We feel rewarded when we employ a transformer with 98% efficiency, or a motor with 95%. We want high efficiency in amplifiers, in meters, relays, power plants, vehicles, etc. The vacuum tube is giving way to the transistor because of the greater efficiency of the latter. If we feed a machine with fuel we want the greatest return for what it consumes. It is a fundamental compulsion of every engineer to achieve maximum efficiency.

Yet in the matter of loudspeakers we have been deceived into believing that efficiency is unimportant. This is a deadly trap that could choke off progress and set back the work of sincere and capable engineers. Low efficiency is totally and fatally wrong. It is contrary to all scientific facts. It arises from the myth that amplifier power is cheap, and this has pushed bad design and sloppy production on us. A large magnet or heavy structure does not necessarily result in high efficiency.

If a reproducer engineer were given the task of building the world's finest speaker regardless of cost, he would ultimately find himself with a speaker of extraordinary high efficiency as an inevitable consequence even though he had not initially made this an objective.

When Western Electric Company was making speakers, they approached 50% efficiency. Three watts of input to a type 555 unit could fill a theatre. Three decades ago P. G. A. H. Voigt, English inventor, built speakers with extraordinary efficiency and fidelity and with one watt could deliver all the sound that one could take in his living room.

Paul Klipsch's Klipschorn is an example of one of the most sensitive reproducers with lower distortion. It is still king of them all on these two points.

It is no accident that the products of old-established and reputable manufacturers show great conversion efficiency.

The Rek-O-Kut "Sonoteer," the first thin-line high efficiency speaker to be marketed, operates from a transistor pocket radio. It receives about one-tenth watt and fills my office comfortably. Rek-O-Kut speakers may be fed from a portable tape recorder, a table radio, or any under-powered device. If you have as much as 10 watts available, you are in a position to drive the dust out of the rug in front of the speaker. Our newest stereo speaker system, "Sonorama," to be released in October, continues our belief in efficiency.

No home should require more than one acoustic watt for high power peaks. If our speakers were made with only 20% efficiency, we would seldom require more than a 5-watt amplifier. Yet some manufacturers advise the use of 30 watts with their speakers. In the case of one acoustic suspension class of speaker which I measured over three center octaves, this showed an average efficiency of less than 1%. If driven by 30 watts, this speaker would be converting 29.7 watts into heat in the voice coil, and only 0.3 watts would be doing useful acoustic work.

Be sure to see and hear the new "Sonorama" at the New York Hi-Fi Show, October 2–6. It is a single unit stereo speaker designed not for shelf mounting, but it is the shelf itself! You bolt it to the wall like a shelf, then place books or objects of art on it.

Rek-O-Kut Company, Inc.
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the only turntable kit with Professional Quality . . .

GRAY PK-33

GRAY PK-33 stereo LP turntable kit shown with Gray's 212-TG tone arm and accessory base.

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FEATURES

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NYLON THRUST ASSEMBLY cushions the steel shaft of the turntable platter in the bottom of the bearing well.

CLEARLY WRITTEN MANUAL guarantees fool-proof assembly. Step by step instructions with photographs and diagrams mean that one evening's work will give you the satisfaction of building your own PK-33.

SIMPLE MOUNTING. The PK-33 can be installed with simple hand tools. Attractive bases, pre-cut, pre-assembled in mahogany, walnut or blonde are available from Gray dealers.

COMPLETE COLOR MATCHING is a feature of all Gray Research products. For example, the 212-TG tone arm shown above complements the "Sunset Grey" finish of the PK-33.

GRAY RESEARCH
AND DEVELOPMENT
CO., INC.
Box 12, Elmwood, Connecticut

RECORD REVUE

(from page 66)

The general type was common enough at the time—"concerti" for all sorts of solo combinations, such as the well known Bach "Italian Concerto" for solo harpsichord. It was the style of writing that counted, the concerto sound and structure, quite unlike chamber music style—we'd call the style Bach-ish or Vivaldi-ish. The Italians invented it, and every composer in Europe wrote Italianate concerto music of the sort—these all sound like Bach or Handel or Vivaldi. But at least some of them have an overlay of French styling in them, especially in the slow movements.

The most interesting are the works for five flutes alone by Boismortier. He has a good deal to say musically, and the odd sound of five flutes, trying to play a full range from treble to bass, is intriguing too. The Corrette concerti are to my ear more conventional and less interesting. They have their bass provided by the harpsichord-cello combination.

The recording is big, live, and at the same time close. This is normal for today, but unfortunately the modern flute player produces an appalling amount of extraneous noise in the form of hissing and spitting—sounds that carry very distinctly for a few yards but are mercifully lost at a greater distance. The hissings of these five flutes are just above the conscious threshold in the listening. It would have been better to push the players back a bit, or get them sidewise or something, to avoid it. I also feel that some (though not all) of these players are not good stylists for the music, playing with that floppy, unphrased looseness that seems to be inherent in many schools of flute playing today. I will name no names though I think I know which of the players may be involved. The difference between the players is quite noticeable and, of course, does add a sense of individuality and personality that is useful, in any such music, style or no.

Hark, The Glad Sound! Music for Recorders and Harpsichord. Carl Dolmetsch and the Dolmetsch Consort.

Angel S35747 stereo

The first recorder music I ever heard, almost thirty years ago, was on a series of ten-inch 78-rpm discs, the English "Columbia History of Music." The music was played by the Dolmetsch family, headed by a wild-haired old man, Arnold Dolmetsch (born 1858)—I had seen his picture often enough. With the late Wanda Landowska, he virtually launched the great wave of "authentic" old music that is now at its height. Dolmetsch built old instruments, played them, taught his family to play them. His Haslemere Festival practically began the age of the restored recorder, lute, harpsichord, viol, and so on.

Today, a new generation of Dolmetsches is in operation, in the same business. I remember the older Dolmetsch children—young Cecile, who sang on the old records in a plaintive little-girl's voice; Carl, the recorder player; Rudolph, who if memory serves was the harpsichord genius of the family. It was a real clan—and now, Carl's own family plays again, including his two sons and twin daughters. After almost 40 years, the Haslemere Festival still continues under the family direction. This record shows what they can do.

I'd say the Dolmetsch family standard of performance has risen rather dramatically since the early days. Quite rightly, for then the old instruments were very "new" and unfamiliar, their techniques mostly lost; whereas today the Dolmetsches compete in every aspect of their work with hundreds of able professionals in many countries, including our own. Under this test the family music holds up well, though for my ear with a slightly old-fashioned sound—a trace on the Romantic side here and there. Rather nice.

The recording features Carl Dolmetsch as lead artist, on both the soprano and alto recorders, contrasting (as is often done today) several of the big solo works for recorder and keyboard out of the Eighteenth century with earlier music for recorder ensemble, numerous instruments of different sizes playing together in "consort." There's a lovely

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Herman Burstein

Written in "plain talk" for the man who has, or wishes to buy, a tape recorder. It answers the myriad questions raised by tape recording enthusiasts. Its chapters cover every phase of operation and maintenance—from adding a tape recorder to the hi-fi system, to a thorough dissertation on microphones. Lots of practical information on how to buy. 176 pages.

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Handel and a Telemann, appropriately ornamented in the recorder part with improvised additions (quite the correct thing to do), plus a batch of pleasant ensemble pieces for the recorder group, minus keyboard. A bit of trouble technically with some very loud recorder notes here and there (the recorder is the very devil to record on tape)—otherwise a fine sound.

Debussy: 12 Preludes, Books I and II complete. Charles Rosen, piano.
Epic BC 1242 stereo

Listening to this major slice of Debussy art, performed by a skillful and sympathetic pianist, I find old thoughts about the composer recurring to me again—somehow, I keep feeling, Debussy was a tremendous musical mind, an original, fearless technician and innovator, a conscious stylist beyond compare—always so precisely avoiding the Germanic tradition, emphasizing the French—and yet, with all this, I find his musical language cold, of the mind and not the inner musical intuition.

In contrast, Maurice Ravel was a much less original stylist though an even greater technician. Debussy was the real leader in musical ideas. But, for me, Ravel's music speaks for real. It comes straight from the musical heart, for better or worse. Give me three or four of Ravel's piercing harmonies and I'll toss you a whole bookful of Debussy's cleverly contrived whole-tone colorations. After half a side of this celebrated music, a turning point in 20th century piano composition—I find myself utterly bored. Not Rosen's fault. Debussy's.

Now I suppose I've committed the ultimate critic's sin. So help me. Æ

TAPE GUIDE

(from page 56)

might disturb such an arrangement, unless it has the same inductance as the old head.

In recording, the bias current requirements will vary with the inductance of the record head. Therefore the use of a different record head will require adjustment of bias current. Also, for a given level of signal to be recorded of the tape, the amount of current supplied to the record head will vary. Therefore the record-level indicator will have to be recalibrated so that it properly indicates maximum permissible recording level (producing 3 per cent harmonic distortion at 400 cps). Sometimes a constant-current resistor is used between the record head driver and the record head, even though the latter is a low-impedance type. A different head may require changing the constant-current resistor. Sometimes the impedance of the head figures in the record-equalization network that produces treble boost; this depends upon the type of record equalization employed. I can't speak for your particular tape machine, but there is a possibility that with some machines a change in the record head would require a change in the record equalization.

Before making any change, I strongly advise you to put the matter to the manufacturer of your tape machine. True, some of the differences resulting from head substitution may be quite slight. But it is clear from your letter that you want the best possible performance from your tape recorder.

Q. I have been planning on purchasing a high-quality tape recorder, and with it I plan to tape FM-multiplex, copy other tapes, and tape live organ and other music. I have been considering the purchase of a four-track machine, but recently have been given reason to doubt the advisability of four-track stereo recording with home tape machines. A (tape) friend of mine, who is also an electrical engineer,

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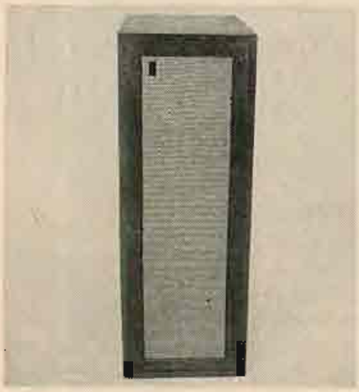

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has had very adverse experiences with four-track stereo recording. He experienced a very restricted dynamic range and found the recording level to be highly critical with distortion and tape hiss prevalent in many instances. It is true I would like the savings of four-track stereo, but not at the risk of any loss of high fidelity, or in difficulty of taping. I would appreciate your personal opinion, as there is a lot of beautiful music waiting to be recorded.

A. I am inclined to vote for a quarter-track (four-track, as you call it) tape machine, provided that you get something in the top quality class. Quarter-track machines have become virtually the standard for home use, and almost all commercial prerecorded stereo tapes are now of this variety. Top-quality home machines are able to achieve signal-to-noise ratios of about 55 db at 7.5 ips, quarter-track, based on a recording level producing 3 per cent harmonic distortion at 400 cps. This meets high fidelity requirements. By going to a half-track machine you wouldn't be doing much better.

True, some home machines fall appreciably below 55 db signal-to-noise ratio, and therefore cannot be classified as high fidelity instruments. Quite a number of home tape recorders attain signal-to-noise ratios of only 45 to 50 db at 7.5 ips, quarter-track. The 5-db difference between 50-db and 55-db signal-to-noise ratio is very precious.

Half-track machines are less subject to dropouts (sudden, brief reductions in volume) because of inconsistencies in the tape oxide. The wider the track, the more chance there is for variations in oxide to average out, resulting in greater constancy of volume. But the continual improvements in tape have made dropouts much less of a problem than they were years ago; so much so that, if you use tape of the best quality, you are unlikely to find that the problem exists even when operating quarter-track.

Quarter-track is advantageous over half-track with respect to azimuth alignment (adjusting the head so that the gap is exactly at right angles with the long dimension of the tape). Azimuth is quite critical in order to preserve response out to 15,000 cps at 7.5 ips. But the narrower the track, the smaller is the treble loss for a given degree of azimuth misalignment. In a stereo head, the two gaps are never perfectly colinear, that is, exactly in the same vertical line. Accordingly, it is not possible to obtain perfect azimuth alignment for both gaps; high frequency response must suffer on one track or the other or a bit on both. But with a quarter-track head there is less suffering.

In sum, using a top-quality home tape machine, you should be able to record all that beautiful music with beautiful fidelity on a quarter-track basis.

Q. I would like to know if you could tell me where I can purchase the standard test tape Ampex 5563 at 7.5 ips and the RCA tape 12-5-64T.

A. I believe that you can obtain the test tapes you want from one or more of the large electronic mail order houses. A number of the large audio dealers also carry test tapes. By thumbing through the pages of one of the audio magazines, you can find the names of a number of mail order houses and audio dealers. I don't know whether Ampex and RCA sell test tapes directly to the consumer, but queries to them should at least bring information as to the dealers who carry their tapes. Æ

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SELL: Professional tape recorder Presto #800 ½-track; speeds 7½, 15 ips. Excellent condition, $850. Lester Salerno, 2212 Hudson Blvd., Jersey City, N. J.

SELL: 19 2400-foot ½-inch Scotch 111A tapes. Seals unbroken $8 each. 2 RCA 44BX microphones, $75 each. Clean 10½-inch aluminum reels (¼-in) in boxes, $1 each. Altec 670B microphone, $50. Will ship. M. E. Boyd, 2924 Bowser Ave., Dallas, Texas.

SELL: Two Electro-Voice factory-finished Royal 400's, wired Citation I and II, Weathers professional record player. Used three months. Cost $1248.10 with accessories. Sell for $920. Steve Anshutz, 904 East 2nd, Ellenburg, Washington.

FOR SALE: Loudspeakers, two Bozak model B-302A, urban oil-finished walnut. Like new, used very little. $165 each. L. J. McDonald, 316 Meisner Avenue, Elkhart, Indiana.

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Industry Notes...

• **Acoustical Consultants Organize.** The organization of a National Council of Acoustical Consultants was formally announced this week. This is a group of firms who supply information and do research on noise and acoustical design problems. The new Council is dedicated to encourage adherence to better standards of acoustical performance in buildings and to control noise wherever found. Membership is open only to firms having primary interests in acoustical consulting engineering. Howard C. Hardy of Chicago was elected president, Michael J. Kodaras of Long Island City is vice-president.

• **TelePrompTer Plans Acquisition.** In furtherance of its expansion program, TelePrompTer Corporation has entered agreements for the acquisition of Conley Electronics Corp. of Evanston, Ill., and TelePrompTer stockholders will be asked at a special meeting on Oct. 9 to approve mortgages to secure the required bank loan, according to president Irving B. Kahn. Conley manufactures endless loop magnetic tape cartridges and related products.

• **Jerrold Names Vice-Presidents.** According to a recent announcement by Sidney Harman, president of The Jerrold Corporation, Roland J. Kalb has been appointed vice-president and general manager of Pilot Radio Corporation; Robert H. Beisswenger appointed vice president of Jerrold Electronics Corporation; Donald Spanier, Harman-Kardon, Inc. becomes vice president; and Paul Garrison, vice president of Technical Appliance Corporation.

• **Foy Forms Consulting Firm.** C. Arthur Foy, former marketing manager of Vega Electronics Corp. following seven years with Ampex Audio, has announced the formation of C. Arthur Foy Co., consultants in marketing and commercial procedures, located at 1550 Siesta Drive, Los Altos, California.

• **New Sales Manager for Gray.** Stuart S. Wood has been named Sales Manager of Gray Research and Development Co. Inc., Elmwood, Conn., according to T. Gerald Dyar, president of the broadcast equipment manufacturing Company.

• **Thomas Organ Appoints.** Murray Fiebert has been named Eastern Regional Manager for Thomas Organ Co., according to Joe Benaron, president. Mr. Fiebert held his post previously, leaving in 1958 to serve as president of Capital Syndication Corp. New York business and sales consulting firm.

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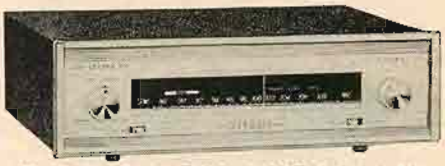

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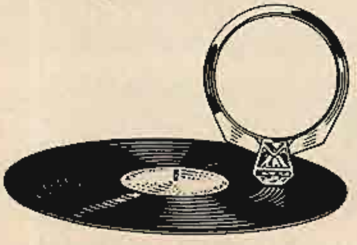

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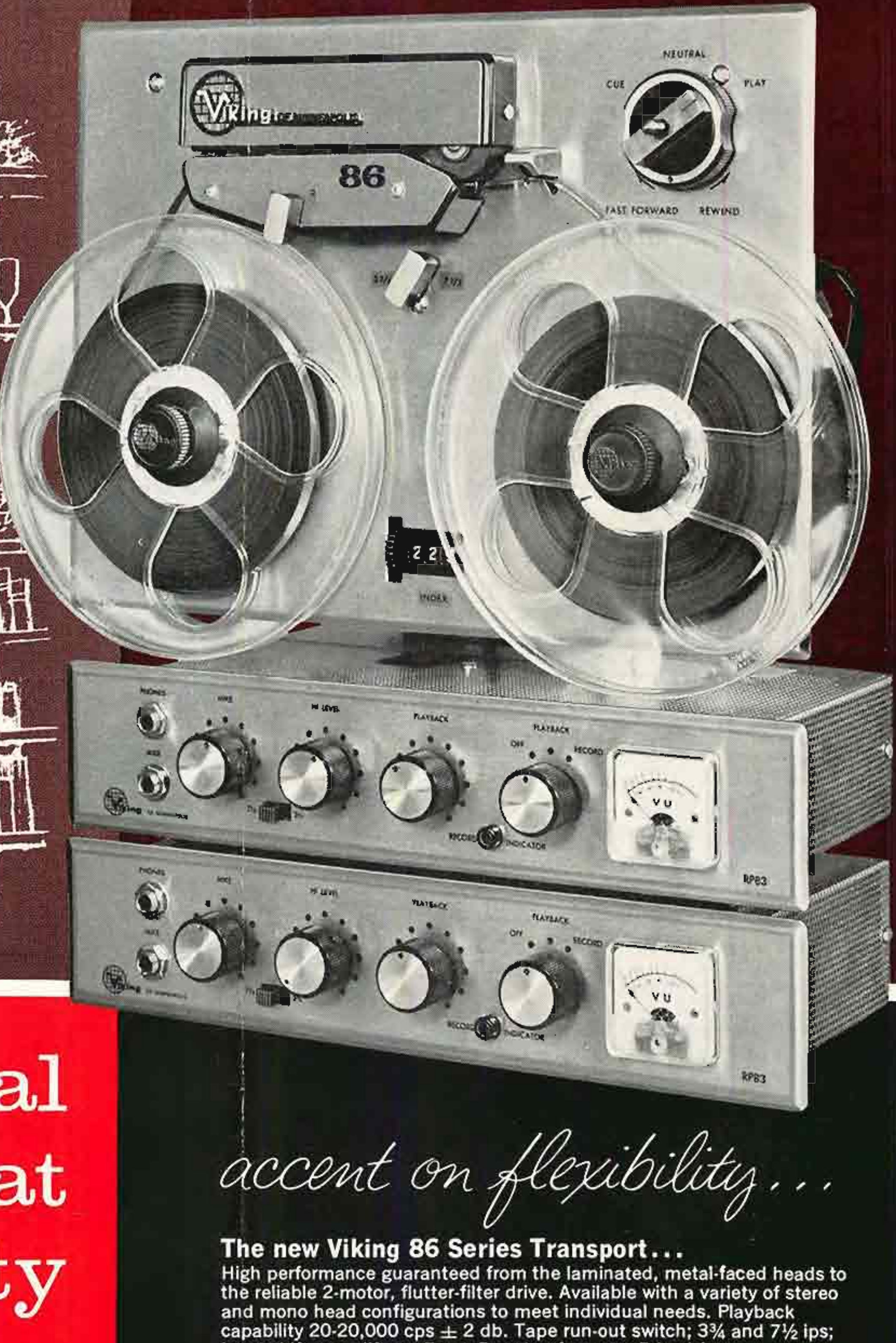

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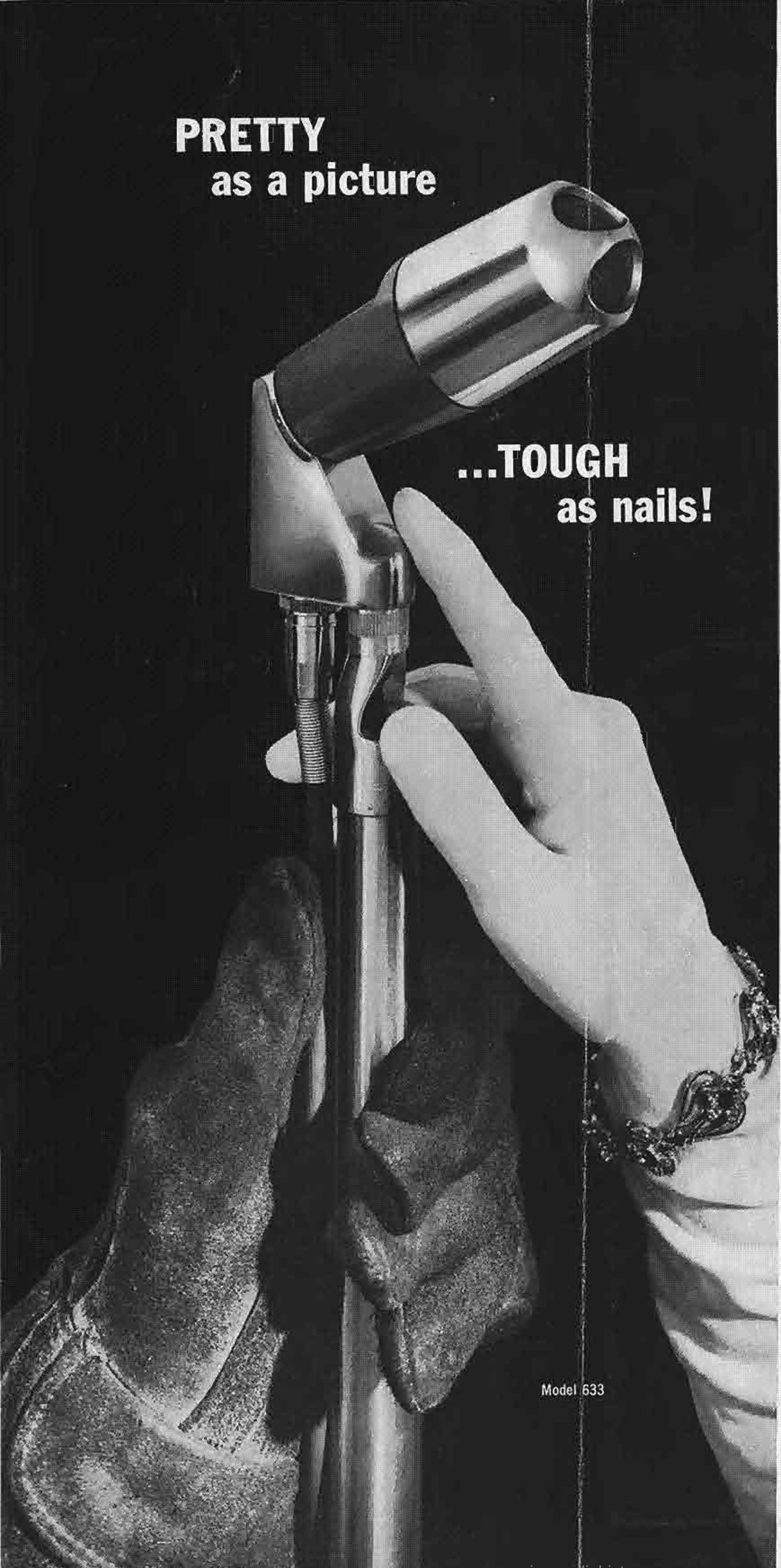

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